A REPORT ON SEWAGE DISPOSAL FOR CHAMPAIGN AND URBANA

BY

WILLARD MARTIN OLSON

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THESIS

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I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY Willard Martin Olson

ENTITLED A Report on Sewage Disposal for Champaign and Urbana.

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE OF Master of Science in Municipal and Sanitary Engineering

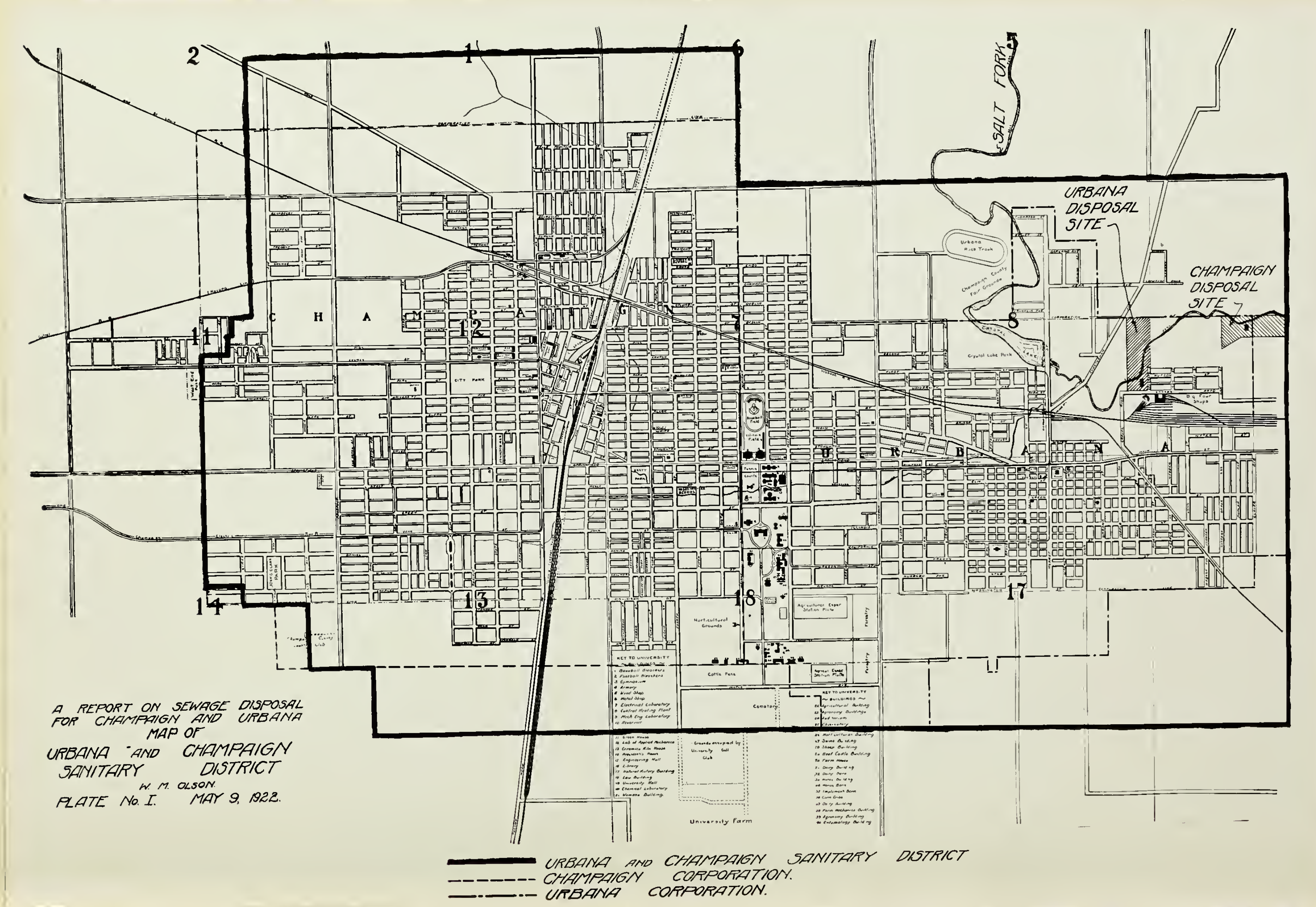
A N Talbot
In Charge of Thesis

A N Talbot
Head of Department

Recommendation concurred in*

Committee on Final Examination*

*Required for doctor's degree but not for master's



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A REPORT ON SEWAGE DISPOSAL FOR CHAMPAIGN AND URBANA

Chapter 1

INTRODUCTORY AND CONCLUSIONS

Many people of Champaign and Urbana appreciate the fact that action must be taken on local sewerage problems and on the final disposal of the sewage collected from the two cities. This report deals only with the problem of sewage disposal. Nuisances have been created by the inadequacy of the present system for the collection of sewage. Personal inconvenience suffered by citizens of the two cities has made them willing to give a hearing to people offended by the present method of sewage disposal. The experiments with different methods of sewage treatment carried on near Urbana by the Illinois State Water Survey have attracted widespread interest. In 1915 the city of Champaign sought the advice of a consulting engineer, Mr. W.S.Shields of Chicago. In his report to the city of Champaign Mr. Shields recommended the adoption of either the activated sludge or the electrolytic process of sewage treatment. In February 1922, the engineering firm of Pearse, Greeley and Hansen of Chicago was selected by the trustees of the Urbana and Champaign Sanitary District to make a preliminary investigation. This firm of engineers has been working on the problem and has submitted progress reports to the Board of Trustees of the Sanitary District.

In this report a careful study of the local problem has been made. The results of this investigation justify the following conclusions.

1. The Urbana septic tank should be abandoned.

2. The land owned by the city of Champaign and at present used as a site for a septic tank should be used for the new disposal works.

3. The sewage should be treated by medium screens, Imhoff tanks, trickling filters and secondary settling tanks.

4. A competent operator should be placed in charge of the disposal plant. He should be paid by the year and should be provided with a suitable residence at the disposal site. He should be supplied with such assistants as may be needed.

5. The estimated first cost of a sewage treatment plant such as outlined above is $410,000.

6. Provision should be made to meet an annual operating expense estimated at $13,000.

Chapter II.
THE TWIN CITIES.

The two cities of Champaign and Urbana are situated in Champaign County, Illinois, about fifty miles northeast of the geographical center of the state. They are about 130 miles south of Chicago, 120 miles west of Indianapolis and 160 miles northeast of St.Louis. The two cities form one community which is best known as the home of the University of Illinois. The greater part of the 240 acre campus of this institution lies within the corporate limits of Urbana but a small part is included

in Champaign. In 1920 the population of Champaign was 15,873 and of Urbana 10,230, making a joint population of 26,103. There were registered in the Champaign and Urbana departments of the University 7,839 students of whom by far the greater part were non-residents and not included in the census of the two cities. The cities cover an area of about 6.7 square miles.

A private water company supplies both cities with water from wells about 150 feet deep. A typical chemical analysis of the water is shown in table 1. Some other private enterprises draw large supplies of water from the same ground water stratum.

Some important industries are located in Champaign. The Cushman Company, Inc., manufactures tools. The Locomotive Crane Co., makes a light self-propelled crane used on highway work. The Burr Co., manufactures a railway dynamometer car, mining machinery and metal products. Shops of the Big Four Railroad are located at Urbana, which is a division point on that road. Urbana is the county seat of Champaign County.

The topography of this area is comparatively flat with just enough small stream channels to provide surface drainage. There is a total difference in elevation of about sixty feet over the settled area exclusive of the depth of small stream channels. The general direction of drainage is toward the east. A very small portion of the extreme west area of the community drains to the west and another small portion drains to the south. Nearly seven per cent of the total area is covered by pavements and the sidewalks beside the pavements. Closely built up business and industrial areas cover about 2.2 per cent of the total area

and most of the remaining area is used for residence purposes. In these large residentail sections about 30 % of the ground area is covered so as to be impervious to water. The soil consists of from one to three feet of black loam underlain by a jointed yellow clay subsoil. This soil drains very well.

Chapter III.
THE PRESENT SEWERAGE SYSTEM.

Both cities are sewered on the separate plan. Storm water is diverted along natural drainage lines to the Boneyard, a small stream which flows in a southerly direction through Champaign and in an easterly direction through Urbana. This stream becomes at times very foul and undoubtedly receives continuously a small amount of domestic sewage. Gagings of Champaign's sewage flow indicate that considerable ground water finds its way into the sanitary sewers. Each city has its own system for the collection of sewage.

Champaign's domestic sewage is concentrated in one main outfall which crosses Urbana in an easterly direction. The disposal site, owned by the city of Champaign, consists of 12 acres of land located about two miles east by north of the point where the main outfall crosses the east boundary of Champaign. At present the Champaign sewage is discharged without any treatment into the west branch of the Salt Fork of the Vermilion River. The West Branch of the Salt Fork, hereafter referred to as the Salt Fork, is a small stream which flows in an easterly direction through the disposal site. The stream has an estimated dry weather flow of one-half million gallons daily during several

consecutive months.

One of the first septic tanks built in the United States was installed at the disposal site in 1897. Two years later this tank was reported as operating in a "very satisfactory manner" on a mean dry weather flow of 300,000 gallons daily. In 1916 this tank was reconstructed for experimental work on the activated sludge process of sewage treatment by the Illinois State Water Survey.

Urbana's sewage is carried through two main outfall sewers to a disposal site about a half mile northeast of the main part of town. This disposal site consists of about 13 acres of land, a part of which is now used as a city dump. At the disposal site the sewage passes through a septic tank of about 115,000 gallons capacity. This tank has been in operation since 1902 and has been operating in a fairly satisfactory manner. The effluent from this tank is discharged into the Boneyard about a quarter of a mile above its junction with the Salt Fork. The Champaign disposal site is somewhat more than a quarter mile downstream from the point where the Salt Fork receives the flow of the Boneyard together with the effluent of Urbana septic tank. The effluent of the septic tank is in a putrescible condition and causes some nuisance in the small stream into which it is discharged. This fact, together with the odors developed at the times when sludge is removed from the tank have caused many Urbana citizens to believe that the septic tank is a failure. In this report it is recognized that this tank will not fit in well with a comprehensive plan of sewage

sewage disposal for the community and therefore should be abandoned.

It is to be noted that all of the sewage from the buildings of the University of Illinois does not go into the Urbana sewers. A large part of the sewage from the University goes into the Champaign sewers.

The present sewage disposal site owned by Champaign is suitable for a site for the sewage treatment works proposed in this report. The land owned by Champaign is favorably located being well to the east and north of present settled areas. The Urbana site is unsuitable. It is too near the main part of Urbana. While the prevailing winds in summer are from the southwest yet it is probable that with most processes of sewage treatment unpleasant odors would be noticeable at times both at the Tuberculosis Sanitarium about a half mile north of the Urbana site, and at the homes of those people living in the built-up blocks immediately to the east. The Urbana site is also insufficient in area, due in part to the fact that it is crossed by the channels of both the Boneyard and the Salt Fork.

Chapter IV.

The Sewage Disposal Problem

The necessity for action to relieve conditions in the Salt Fork has for some time been recognized by many citizens of the Twin Cities. The situation may be briefly described by saying that the present methods of disposing of sewage have caused the Salt Fork to become a nuisance for many miles below the sewer outlets. Farmers living several miles down stream in

houses situated as much as a half mile from the water course, complain of odors which become intolerable during the dry months of the year and of odors which are noticeable at all times. They say that they are put to the expense of providing fences to prevent their livestock from drinking the polluted water. While there has been much complaint from nearly all property owners downstream there have been no damage suits filed against the cities and there has been no formal statement of grievances to the governing bodies of the two cities. The State Board of Health has suspended threatened action in order to give the cities a reasonable time in which to take the necessary measures for relief. About 20 miles downstream at the village of Homer (1920 pop.978) there is a public bathing pool supplied with water from the Salt Fork. It has been suggested that cases of typhoid occurring among users of this pool might be directly chargeable to pollution from the Twin Cities.

Continuous gagings of flow in the Salt Fork are not available. On October 1, 1917 a measurement at low stage was made below the Champaign sewer outlet by Mr. G.C.Habermeyer, the engineer of the Illinois State Water Survey. The rate of flow was found to be 3,000,000 gallons per day. The flow exclusive of local sewage was estimated at half this amount. The stream has not been known to run dry during the last twenty years but during the dry summer months the flow is said to be very small. An estimate of the rate of flow to be expected at the present Champaign sewer outlet has been made based upon the drainage

area and upon gagings of the Sangamon River near Monticello and of the Vermilion River near Danville as reported by the United States Geological Survey in their Water Supply Papers. The drainage area of the Salt Fork is estimated at 76 square miles, from United States Geological Survey topographic sheets for the Mahomet and Urbana quadrangles and from a Drainage Reclamation Map on a scale of about 8 miles to the inch compiled by the State Geological Survey Division in 1920. This drainage area is small compared to that of the Sangamon River near Monticello, 550 square miles, and that of the Vermilion near Danville, 1280 square miles. Plate 2 shows the mean monthly run-off in cubic feet per second per square mile at Monticello from February 1908 to December 1912 and from July 1914 to September 1918. It also shows the same for Danville over the period from November 1914 to September 1917. Expressed as run-off from an area of 76 square miles these values would indicate a variation in mean monthly flow of from 319,000 gallons per day to 322,000,000 gallons per day. The frequency curve in Plate 3 shows the per cent of the total time which a rate of flow of a given amount, or greater, has occurred during the 109 months of record. Tables 2 and 3 give the data from which this curve was plotted. For example, a rate of flow of 30,000,000 gallons daily, or more, occurred during 39 of the 109 months or 35.8% of the time covered by the available records. Conversely Plate 3 shows the minimum rate of flow which it is reasonable to expect for a certain part of the time. For example, for 20% of the time a rate of flow of at least 53,000,000 gallons daily may be expected.

Table 1 gives the mean of two analyses of water from the Salt Fork.

There are seven villages of from 200 to 1000 population along the forty miles of the Salt Fork between the present Champaign sewer outlet and the junction of the Salt Fork with the Vermilion River immediately below Danville. None of these villages takes its water supply from the stream. As before mentioned there is however, a public bathing place at Homer. If the two cities so treat their sewage that no putrefaction can take place in the Salt Fork between Urbana and Fithian (the next village past Homer) they will have done all that can reasonably be required of them. This report proposes to recommend a method of treatment which will effect such a result. To accomplish this the effluent of the treatment plant must be such that at all times when mixed with the water flowing in the Salt Fork the dissolved oxygen content of the mixture will not fall below 50% saturation in the 25 miles of stream immediately below the present sewer outlet.

The sewage from Champaign and Urbana is a domestic sewage of about average strength. It contains practically no industrial wastes. The largest local producer of liquid waste is the gas plant and this establishment has within the past few years adopted a system whereby the liquid ordinarily wasted can after some treatment be used over and over again. None of it reaches the sanitary sewers. The Champaign sewage reaches the outlet while yet fresh. This is shown by the high nitrite and nitrate content.

The State Water Survey has made a great number of analyses of Champaign's sewage. Of these analyses, those used in this report were made upon sewage which had been screened by passage through a Dorrco screen with openings consisting of slots 1/2 inch by 1/16 inch. The weight of dry screenings removed from the sewage amounted to 4.1 to 12.2 parts per million. This amount of screenings is less than one per cent of the remaining total residue. In this study no attempt is made to correct analyses for the amount of solid matter removed by the screen. Table 4 shows the average of analyses of 234 sewage samples. Due to infiltration into the sewers there are marked variations in quality. In Table 5 average analyses are given for fifteen groups each representing from six to nineteen daily sewage samples. Altogether these groups represent 168 samples.

In order to meet this sewage disposal probelm a sanitary district has been organized with boundaries as shown in Plate 1. It will be noted that the district includes all of Urbana, most of Champaign, and some outlying territory. The part of Champaign not included in the sanitary district is that portion of the city which is not in the drainage area of the Salt Fork, and which cannot be economically served by sewers having an outlet on the Salt Fork. The sanitary district is a new municipal corporation with taxing and bonding powers. This sanitary district was organized in the spring of 1921 under the provisions of the Illinois law of 1917 relating to the creation of sanitary districts. The corporation may acquire, by condemnation if necessary, any property required to serve the purpose of the district. Upon

vote of the electorate it may issue bonds in amount up to 5% of the assessed valuation of property in the district. The governing body of the sanitary district may levy a tax up to 1/3% annually on this assessed valuation and with the approval of the voters of the district may increase this tax levy to 2/3%. In 1921 the combined assessed valuation of the two cities was $11,310,000. A small part of this is not included within the bounds of the district but the rural territory included in the district is probably sufficient to bring the assessed valuation of the sanitary district well above the figure quoted for Champaign and Urbana. Works for the betterment of present conditions need not be held up for lack of funds if the voting sentiment is in favor of the issue of the necessary bonds.

Chapter V.

QUANTITY OF SEWAGE

Works constructed for the treatment of sewage should be of a size sufficient to meet conditions reasonably to be expected at some future date. It is difficult to state arbitrarily the length of time for which provision should be made. The art of sewage treatment has made much progress in the past thirty years and there is every reason to think that progress in the next three decades will be no less. For this reason it is well to consider the possibility that works constructed today may in a few short years become obsolescent if not obsolete. On the other hand works constructed for municipal purposes when once completed are commonly thought of as "done" and new construction is improbable within a considerable period of years. In this

report definite recommendations will be made to meet estimated conditions fifteen years hence (1936) with provisions for possible extensions to meet conditions twenty-five years hence (1946). When speaking of "present" conditions reference is made to the year 1921, in which much of the data used here were obtained.

Plate 4 shows the combined population of Champaign and Urbana since 1860. It also shows the way in which the population of some other Illinois and Indiana cities has increased. The curve is projected into the future at a slope which gives about equal weight to the past growth of the Twin Cities and to the growth of the other cities shown. The registration in Champaign and Urbana departments of the University of Illinois is also shown. This last quantity has shown an average annual increase of about 11%. It is improbable that that rate of increase can long continue and therefore the curve is not projected into the future. An estimate made in the office of the Supervising Architect of the University of Illinois sets the 1940 registration in Champaign and Urbana departments at about 20,000. This value has been taken as the most reasonable one. Tables 7 and 8 give the data from which Plate 4 was prepared. The 1936 population of the Twin Cities is estimated to be 41,600 and of the University 19,000. For 1946 the corresponding figures are 51,200 and 21,000.

The Illinois State Water Survey made hourly gagings of Champaign's sewage flow during the greater part of the year 1921. The sewage measured at the sewer outlet included

that from the population of Champaign, that from a large part of the transient student population, infiltration and some storm water, and a large part of the water supply of the University of Illinois. Plate 5 and Table 9 show the observed hourly variations in flow.for typical days. Plate 6 and Table 11 show daily variations during typical weeks. Plate 7 and Table 12 show the calculated average rate of flow in million gallons daily for each week of the time of record. It also shows the accumulated rainfall for each week.

The flow about 6 A.M. on a dry summer's day is mostly ground water and this occurs at the rate of 400,000 gallons per day, a rate equal to 30% of the mean rate of flow for the year. The gagings for typical dry weeks indicate that during the summer about 830,000 gallons per day, a rate equal to 61% of the mean for the year, is the normal rate of flow of domestic sewage. Mean weekly rates greater than this are indicative of infiltration or of storm water. During the winter months 1,110,000 gallons per day is about the normal rate for domestic sewage. This normal rate during the winter months is 82% of the mean for the year. During by far the greater part of the year there will be some infiltration to be taken care of. This infiltration will, however, not be an excessively large per cent of the normal flow if the mean rate for as long a time as one week is considered. The maximum recorded rate of flow during any one week is 2,237,000 gallons daily or 201% of the normal rate of flow. The effect of the infiltration is to dilute the sewage and to add tothe amount of liquid to be treated. At times of greatest storm flow the dilute sewage can be passed through

the treatment plant at an increased rate but in general it would be unwise to attempt to treat a flow of 2,000,000 gallons daily of dilute sewage with the same units designed for 1,000,000 gallons daily.

The mean rate of flow for the 306 days of record is 1,354,000 gallons per day, equivalent to 66 gallons per capita daily based on a tributary population of 20,610. This approximation neglects entirely any complications due to the effect of the University of Illinois pumpage or to the absence of the student population over a part of the year.

In making the estimate of probable sewage flow in 1936 attention must be given to the fact that a part of the water used by the University of Illinois goes into the Champaign sewers and is included in the gagings reported by the Illinois State Water Survey. Since the average daily use of water at the University is 444,000 gallons the increment in flow due to a part of this, is worthy of especial consideration. In order to make clear the effect of the large use of water at the University it is necessary to segregate this item from the rest of the Champaign sewage flow. The Superintendent of Buildings at the University supplied meter readings showing the amount of water pumped by the University plant during 1921. The water distribution system of the University is connected through a valve with the distribution system of the Champaign and Urbana water company. Each pumping plant can increase the supply of the other in time of need and considerable water has been interchanged in this way. The meter readings previously mentioned were corrected by the

amount of water thus interchanged in order to give the true amount of the use of water at the University. Table 13 shows the amount of water given and received by the University pumping plant. Tables 11, 14 and 16 show the corrected figures for the use of water at the University. Some of the buildings on the University campus are connected to the Champaign sewers and the rest are connected to the Urbana sewers. The Superintendent of Buildings ordered the measurement of the water used by each building in order to enable an estimate to be made of the probable distribution of the water supply between the two sewer systems. Table 17 shows for each building the observed rates of flow and also the per cent of the mean total rate of flow for the three weeks of record. Meters at a few of the buildings were not read and the percentages for these buildings were estimated. The results of this study show that of the total water supply of the University 46.0% reaches the Champaign sewers, 39.3% reaches the Urbana sewers, and 14.7 % is not returned to the sanitary sewers. That part of the water supply not returned to the sanitary sewers includes boiler make-up water, which is evaporated, water used in the swimming pools and water supplied to those drinking fountains which are connected to the storm sewers. The University campus is well underdrained by storm sewers. During the year of 1921, however, very little water was used for sprinkling the campus.

In this study it is assumed that the University students are distributed between Champaign and Urbana in proportion to the 1920 census population 61:39. It is also

assumed that infiltration of ground water into the sewers will be proportional to the population, that the rate of sewage flow will be proportional to population and that the use of water at the University will increase in proportion to the estimated enrollment. To estimate the rate of sewage flow in the future first the recorded rate of flow for Champaign must be corrected by subtracting 46.0% of the use of water at the University for the same period. Then to this corrected rate of flow a factor based on the present population of Champaign and the future population of the district must be applied and to this product the estimated future use of water at the University must be added. By the use of the proper factors this method will give figures for any particular future date. The method may be made more clear by the following sample calculation.

To determine the mean daily rate of flow for the year 1936. The rate for 1921 was 1.354 million gallons daily from Champaign with a contributing population of 20,600. Forty-six per cent of .444 (the mean daily use of water at the University) is .205 million gallons daily. The corrected rate of flow from Champaign is 1.354-.205 or 1.149 million gallons daily. For 1936 the rate from the whole area of the sanitary district, exclusive of that from the University will be $\frac{60,600}{20,600}$ (1.149) or 3.38 million gallons daily, and from the University will be $\frac{19,000}{8,000}$ (.853)(.444) or 0.90 million gallons daily, making a total rate of flow from the area within the sanitary district of 3.38 + 0.90 or, 4.28 million gallons daily. The factor .853 is the proportion of the total pumpage going into the sanitary sewers.

Table 18 has been calculated to show estimated mean rates of flow for most of the weeks of 1946. Since fluctuations in flow will undoubtedly not occur on the same dates as those observed in 1921 these data are not shown in graphical form but are tabulated to give some idea of variations reasonably to be expected. For example, during the dry part of the summer a flow as low as 2.5 million gallons daily may be expected while a wet week in spring may show a mean rate of flow of 6.6 million gallons daily. Sixty one per cent of the mean for the year or 2.6 million gallons daily appears to be a reasonable value for the normal rate of flow during dry weeks in the summer, and for similar conditions in the winter 82% or 3.5 million gallons daily is the normal rate of flow for domestic sewage only.

Table 19 has been calculated to show variations in flow during the week for different conditions. Results are shown graphically in Plate 6. It is to be noted that the greatest flow is to be expected on Tuesday unless a heavy rain occurs on some other day.

In estimating variations in flow throughout the day at the sewer outlet separate estimates of flow for Champaign, Urbana and the University were made. It was assumed that 2.0 hours are required for sewage to flow from the main part of Champaign to the sewer outlet; that sewage from the University reaches the plant 0.4 hours sooner than that from Champaign, and that sewage from Urbana arrives 1.1 hours sooner than that from Champaign. Table 20 shows the data prepared. To make the estimate, curves were plotted for the sewage flow from each of

the three sources and then combined by graphical addition as shown, for a dry winter's day in Plate 5. The effect of thus combining the curves is to flatten out the hourly variations in flow to be expected. The two other curves showing the 1936 estimate on Plate 5 were gotten in the same manner but the three original curves are omitted to avoid crowding the sheet. The results of this study of quantity of sewage showing observed conditions in 1921 and estimated conditions for 1936 and 1946 are shown immediately below.

Year	Population U.S. Census	Student	Total	Av. Rate of Flow Gal. per capita daily.
1921	16,220	4,390	20,610	65.7
1936	41,600	19,000	60,600	70.7
1946	51,200	21,000	72,200	69.6

	Rate of Flow Million Gallons Daily			Per Cent of Average		
	Minimum	Average	Maximum	Minimum	Average	Maximum
1921	.300	1.354	2.930	22.2	100	217
1936	1.03	4.28	8.41	24.1	100	197
1946	1.26	5.02	9.50	25.1	100	189

The minimum and maximum rates are for one hour only. For 1936 the absolute values for the maximum and minimum rates of flow were estimated from the curves showing daily variations (Plate 5). The maximum being taken as that shown for a wet day and the minimum as three fourths that shown for a typical dry summer's day. From these absolute values the ratios to the average were calculated. For 1946 the ratios of maximum to average and average to minimum were calculated from those of 1936 on the assumption that these ratios would change in inverse proportion

to the fifth root of the tributary population in thousands. (Sewerage and Sewage Treatment by H.E.Babbitt,1922, p.36). From these ratios the absolute values for maximum and minimum were calculated.

The variation in the values for the rate of flow in gallons per capita daily is due to dealing with the University pumpage separately.

The estimates of infiltration of ground water and storm water to be provided for as developed here may be looked on as conservative. The city of Champaign is now planning a comprehensive system of storm sewers which will take a part of the storm water load from the present system of sanitary sewers in Champaign.

Quantity of sewage as here estimated is an important factor in the determination of the kind and extent of sewage treatment to be provided. The rate of flow however must be considered in relation to the quality of the sewage as well.

The critical condition with regard to dissolved oxygen content downstream in the Salt Fork occurs when a period of low flow in the Salt Fork coincides with the discharge of a large volume of strong sewage at the sewer outlet. An attempt is here made to bring out any relation existing between the rate of sewage flow and the strength of the sewage. The strength of the sewage is expressed by an abstract number which is the strength index. For any particular sewage it is calculated from the chemical analysis of that sewage. The strength index is the product of four quantities, namely, the results of the tests for

oxygen consumed, total residue, chloride and the sum of the results of the tests for ammonia nitrogen and organic nitrogen. In Table 5 column 6 gives the strength index for each of the fifteen groups of sewage analyses. Plate 8 shows this strength index plotted against the rate of flow expressed as a percentage of the mean for the year. In general some sort of relation seems to exist between the rate of sewage flow and the strength of the sewage.

This study of the quantity of sewage indicates that in 1936 an average rate of flow of 4.28 million gallons daily is to be expected. This average rate of flow is the equivalent of 70.7 gallons per capita daily from a population of 60,600. The rate of flow bears some relation to the difficulty with which the sewage can be treated.

Chapter VI.

DISCUSSION OF METHODS OF DISPOSAL

The method of disposal to be adopted for this community should be the one which will produce the desired result with the lowest total cost. Both the required degree of treatment and its total cost depend upon local conditions. In Chapter IV it was stated that no putrefaction should be permitted to take place in the Salt Fork for 25 miles below the sewer outlet. There are a number of methods or combinations of methods of sewage disposal which can be relied on with a reasonable degree of certainty, to give this result. Of these different methods of disposal three different combinations have

been found in practice to give satisfactory results under conditions similar to those obtained here. These combinations of methods have been chosen for special consideration and are: (1) medium screening and activated sludge; (2) medium screening, Imhoff tanks, trickling filters and secondary sedimentation; (3) coarse screening, fine screening, trickling filters and secondary sedimentation.

The degree and duration of treatment required have been studied on the basis of dilution requirements. Hazen's formula represents the degree of dilution required to oxidize sewage and prevent nuisance. The formula is usually expressed as

$$D = \frac{Fm}{O}$$

in which O is the amount of dissolved oxygen in the water in parts per million, m is the result of the oxygen consumed test, expressed in parts per million, and F is a factor depending upon the method used for determining the oxygen consumed and which is approximately 2.0 for the 30 minute test used by the State Water Survey.

Plate 9 shows estimated variations by months in the water temperature in Salt Fork, the dissolved oxygen content (70% saturation), the rate of flow, and the rate of flow of diluting water required.

Table 22 has been prepared to show variations in dilution requirements by months. *Efficient sedimentation will reduce the dilution requirement of a sewage by 30%.

* Report on Sewage Works Operation to the Sanitary Engineering Section of the American Public Health Association, Oct. 1919.

Efficient fine screening should remove 30% of the suspended solids in a sewage.* Since about half of the organic matter in ordinary sewage is in suspension, fine screening should remove 15% of the total organic matter. Fine screening should, therefore, reduce dilution requirements by 15%. In general the results of the application of Hazen's formula in the development of Table 22 appear entirely reasonable. The table shows that for one month each year no treatment is necessary. Proper sedimentation will give an effluent which can be cared for by the stream four months each year. Effective screening on the other hand will not add materially to the time during the year when no further treatment is required. The treatment to follow either of these preliminary processes must be capable of changing a daily sewage flow of 4,000,000 gallons of strength index 230, to a stable effluent. The supplementary treatment, following either of the two preliminary processes, will be working nearly to capacity during August, September and October. If preliminary sedimentation is used, the additional treatment will operate on an average at 70% of full rated load for the eight months each year when further treatment is required. If preliminary screening is used the supplementary treatment will operate on an average at 58% of full rated load for the eleven months each year when it is required.

The activated sludge process when operating with a sewage which has been subjected to medium screening with no

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* C.H.Hurd in Engineering News-Record, Vol.88,p.484,1922.

Kenneth Allen in Transactions of the American Society of Civil Engineers, Vol. 78, p.950, 1915.

appreciable reduction in oxygen demand would operate on an average at 65 per cent of full rated load for the eleven months of the year when it is required.

The activated sludge process is one of the newer processes of sewage treatment which has attracted considerable attention. It is essentially an aeration process depending upon the continuous bubbling of air through the sewage while it is carrying a proportion of biologically active sludge in suspension. Domestic sewage should be passed through a medium screen before treatment by this process, in order to remove coarse suspended matter. This method of sewage treatment will produce a clear,sparkling, non-putrescible effluent. If desired however a lesser degree of purification may be effected in order to make use of available diluting water. A point which may assume considerable importance is that this process conserves the nitrogen in the sewage. At the present time the sludge formed has some value. A properly operated plant is entirely free from unpleasant odors.,This fact is not of great importance in connection with the problem under consideration on account of the isolated location of the proposed treatment site. But little head is lost in the passage of sewage through an activated sludge plant. The head available at the proposed treatment site is more than sufficient for an activated sludge installation and the sewage could be treated without pumping. The experimental work done by the Illinois State Water Survey has demonstrated conclusively that Champaign's sewage can be treated successfully by the activated sludge process. Perhaps the greatest disadvantage

of this process, especially from the point of view of the small plant is that it is complicated and requires expert management. The sludge formed must be disposed of soon after removal from the tank or a nuisance will result. The reduction of this sludge to a marketable condition is difficult and disposal by simpler methods requires considerable land area. In general the installation cost of an activated sludge plant is low and the cost of operation is high.

The use of Imhoff tanks and trickling filters is the second method considered. Sedimentation in Imhoff tanks is a common means of removing part of the solid matter suspended in sewage. The removal of a part of this suspended matter is a necessary precedent to satisfactory treatment by a trickling filter. An Imhoff tank when properly operating removes a large part of the settleable matter from sewage in a relatively short time, and delivers an effluent which is comparatively fresh. The sludge accumulating in the lower compartment of the tank is given ample time for digestion, is reduced considerably in volume, and when well ripened is not particularly difficult of disposal. Imhoff tanks are commonly built with a total depth of from 25 to 35 feet. The greater depths give a sludge which is easier to handle and dries more rapidly. The difficulty and expense of construction are important factors in determining the depth adopted. For this installation deep tanks would be desirable in order to lighten the difficulty of sludge disposal due to the damp climate and comparatively light soil. Imhoff tank treatment effects a considerable reduction in the oxygen demand of the applied sewage. It was brought out in connection

with Table 22 that this treatment alone would suffice for four months out of the year. This means that by the use of Imhoff tanks the sewage can be treated without pumping for one third of the time. Imhoff tanks when properly operating require very little attention. It is desirable, however, that an attendent should inspect them at least twice a day in order to prevent too much scum from clogging the gas vents and to keep the slots open to the sludge chamber.

The third method of treatment considered involves the use of fine screening instead of sedimentation in Imhoff tanks. Fine screening is another means of removing solid matter from sewage. This is a method of treatment which appeals to the popular mind and it alone might be sufficient to stop temporarily all complaints from land owners below the sewer outlet. Fine screening is usually adopted as an alternative to sedimentation where land values are high or where the excavation for tanks is expensive. Neither of these considerations obtains here. A fine screen plant would require constant attention and power for operation. It would be necessary to provide for prompt disposal of the screenings. At a small plant such as the one under consideration this would mean that small quantities of screenings would be demanding attention at frequent intervals. For satisfactory treatment, as previously outlined it would be necessary to pump the sewage from the screens to further treatment during eleven months of the year.

The trickling filter as a means of final treatment should be entirely satisfactory for this installation, from

every point of view except that of cost. The cost due to the price of material will be especially high here. This method of treatment involves a large loss of head through the plant. This loss of head is considerably more than the head available at the proposed treatment site and therefore all of the sewage treated on the trickling filter would have to be pumped. Among minor disadvantages may be noted nuisances due to odors and to flies which swarm about the filters in hot weather. The sewage from Champaign and Urbana will reach the point of disposal in such fresh condition that markedly bad odors are not to be expected. This method of treatment requires much less land area than other methods of oxidation involving filtration. An acre of trickling filter will treat about as much sewage as 70 acres of intermittent sand filter. It is worth noting that the effluent of the trickling filter is inferior in quality to that of the sand filter. For the case under consideration the sand filter would give an effluent of an unnecessarily high degree of purity. The trickling filter is an old and tried method of sewage treatment and is entirely reliable. When followed by secondary sedimentation it is able to give an effluent which will require no dilution.* The cost of pumping will be the chief operating cost. The choice between the adoption of the trickling filter and the activated sludge process must be made entirely from a consideration of relative costs.

The use of fine screening as a preliminary treatment has been dropped from consideration in the comparison of costs which follows. As brought out in a previous paragraph fine

*Eng. News Record, Oct. 1919, Vol. 84, p. 1161. Report on Sewage Works Operation. American Public Health Association.

screening is particularly adapted to certain definite conditions which do not obtain here. The adoption of fine screening as a preliminary to filtration would increase the period of pumping from 8 to 11 months yearly and thus add unnecessarily to the cost of operation.

Table 23 has been prepared to show the estimated cost of sewage treatment by Imhoff tanks and sprinkling filters, and the cost of treatment by the activated sludge process. This table is based largely on data given by Mr. H.P.Eddy in the Engineering Record, Vol.74, p.557, 1916. His data are listed in the lower part of the table. He estimated power for the activated sludge process to cost 1¢ per kilowatt hour. In this study power has been estimated at 5¢ per kilowatt hour. This is a probable minimum figure for the vicinity of Champaign and Urbana. In estimating activated sludge power costs it was assumed that 1.5 cubic feet of air at a pressure of 7 1/2 pounds per square inch would be required for complete treatment of one gallon of sewage. Since sufficient diluting water is available to make complete treatment unnecessary during the greater part of the year, 65 per cent of 1.5 gallons or .98 gallon was taken as the average amount of air to be required per gallon during eleven months of the year when the plant is to be in operation. See column 11, Table 22.

If Imhoff tanks and trickling filters are installed the tanks alone will be expected to give the sewage sufficient treatment during three months of heavy sewage flow. During the months when the trickling filters will be most needed the rate of sewage flow will be less than during the months when consider-

able diluting water is available. For this reason the Imhoff tanks should be designed for a greater rate of flow than the sprinkling filters. This requires that in the comparative cost estimate a distribution of cost must be made between the Imhoff tanks and the trickling filters. The distribution of first cost was made from cost data on the Fitchburg, Mass. plant, given in American Sewerage Practive, Vol 3, p.619. The distribution of operating cost was made roughly from cost data on a vertical flow sedimentation and trickling filter installation at Gloversville, N.Y.*. Power for pumping was estimated at 5¢ per kilowatt hour.

In figuring fixed charges the interest rate was taken as 5 per cent and the useful life of the plant as 17 years. The annual rate of depreciation corresponding to this interest rate and plant life is about 4 per cent, making the total fixed charges on capital equal to 9 per cent annually.

This cost comparison shows clearly that the activated sludge process is financially inferior to an Imhoff tank and trickling filter installation for sewage treatment at Champaign and Urbana.

Chapter VII.

THE ADOPTED METHOD

In the previous chapter it was shown that sewage treatment by coarse screening, Imhoff tanks and trickling filters was particularly adapted to local conditions. In this chapter

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* American Sewerage Practice. Vol.3, p.624, 1916.

a preliminary design of such a plant will be developed. General design data for 1936 conditions are as follows:

(1) Population (including 19,000 students)....60,600
(2) Sewage Flow, million gallons daily
Average.........................4.28
Maximum.........................8.41
Minimum.........................1.03
Maximum Dry weather.............5.00

(3) Topography Flat
(4) Soil at Plant
Ordinary Glacial Till...........10!
Water Bearing Gravel.............1!
Compact Yellow Clay..............8!

(5) Elevations to Ill.State Water Survey Datum
General Ground Surface..........95.0
Salt Fork..
Normal Low Water.........86.3
High Water...............97.0
Sewer at Inlet to Plant*........95.0

(6) Diameter of Inlet Sewer....................27"

For 1946 the rate of sewage flow is estimated to be 5.02 million gallons daily or 117 per cent of the average for 1936.

Plate 10 shows a map of the adopted disposal site and also shows the general layout suggested for the sewage treatment plant.

The raw sewage upon entering the plant is to pass through a bar screen. The maximum velocity in the screen chamber is to be 1.5 feet per second. At the screen chamber provision should be made for by-passing all of the influent sewage.

After screening the sewage is to go to the Imhoff tanks. Since the tank treatment is to be the only treatment provided during three months of the year the tanks should be

*Elev. 95.0 corresponds to elev.58.55 on the datum used in the original design of Champaign's sewers, and corresponds to an elevation of 700feet above sea level.

designed for the greatest average rate of flow for one of those months or 6.1 million gallons daily. Four tanks are designed, each to have a capacity of 1.525 million gallons daily. A retention period of 2.5 hours is used. The required capacity of the sedimentation chamber is 159,000 gallons. The Imhoff tanks are to be rectangular, longitudinal flow tanks, 90 feet long. The average velocity of flow will be 0.60 feet per minute. At times of maximum flow the velocity will be 0.83 feet per minute. The sedimentation capacity is to be provided by three flowing through channels, each 9.2 feet wide with a depth at the side of 5.1 feet and with the inclined sides of the bottom sloping 1.5 vertical to 1 horizontal. Two scum chambers, 2.7 feet wide, are to be provided between the flowing through channels. The total horizontal area of these scum chambers is to be made equal to one quarter of the area of the sludge digestion chamber. Sludge digestion space is to be provided in three hoppers. In transverse section, these hoppers are to be 20.8 feet wide at the top, 0.8 feet wide at the bottom, and with sides sloping 1 vertical to 1 horizontal. The sludge storage volume is to extend upward 1 foot above the sloping sides of the hopper. This will allow 18 inches vertical clearance between the lip of the slot in the flowing through channel and the top of the sludge storage space. The volume thus provided will be equal to 8520 cubic feet. This will provide storage for 157 days at the rate of .0035 cubic feet of sludge per capita daily.

The total inside depth of each sedimentation chamber

is to be 12.0 feet and the total inside depth of the tank is to be 26.0 feet. The normal water surface is to be at elevation 95.0 About a foot freeboard should be allowed above this. The influent sewage is to enter through submerged gates, one at the end of each flowing through channel and the effluent is to pass over weirs the width of the flowing through channels. If the tops of the tank walls are set at elevation 96.0 the tanks will probably be flooded by the Salt Fork occasionally. In the general layout space is to be left for one more tank to provide for enlargement to meet 1946 conditions. Sludge is to be pumped from the ta nks through an 8 inch pipe by the use of an air lift. If the sludge is lifted to a distribution tower 7.5 feet above normal water level in the tank it can be directed by gravity to any part of the sludge drying beds.

The sludge drying beds are designed on the basis of 350 square feet of surface per thousand population contributing for Imhoff sludge and on the basis of 100 square feet per thousand population for secondary tank sludge. It is thought best to build the sludge beds large enough to meet 1946 conditions since a large part of the work is earthwork best done while the major job is in progress and since the allowances made for sludge drying area are uncertain at best. An area of 31,400 square feet or 0.72 acres is to be provided. The beds are to consist of 6 inches of 1 inch crushed stone overlain by 10 inches of fine gravel. The sludge drying beds are to be underdrained by 8 inch tiles laid in rows 10 feet apart.

The surface of the beds is to be at elevation 96.3. They are to be surrounded by an earthern embankment two feet wide at the top (elev.98.0) with side slopes 2 horizontal to

1 vertical. The effluent of the sludge drying beds is to be passed through the secondary sedimentation tanks.

The effluent of the Imhoff tanks must be pumped before it can be treated on the trickling filter. Since the greatest rates of sewage flow occur only after a rain a portion of these greatest sewage flows may be by-passed to the Salt Fork after sedimentation, without the necessity for further treatment. An overflow weir about 20 feet long will be placed between the effluent channel of the Imhoff tanks and the suction well. This overflow should be set to by-pass any excess over 5.2 million gallons daily. The maximum dry weather flow is estimated to be 5.0 million gallons daily. On account of the use of the overflow, the amount of settled sewage pumped and treated will be less than the average for the months considered. Of greater importance is the fact that by the use of the overflow weir a less flexible pumping plant may be installed than if the pumps were required to handle the greatest rates of flow occurring, and that the trickling filter may be operated at a more nearly uniform rate.

The partially treated sewage flowing below the crest of the overflow weir will go to the suction well. This wet well will be 7 feet deep below the high water level at elevation 94.50. In plan the well is to be 12 feet by 17 feet with a capacity of 7650 gallons. The ends of the suction pipes are to be set 2 feet above the floor of the suction well. The suction well is to be the basement of part of a building housing an office and laboratory, and the room containing the pumping machinery. The room for office and laboratory purposes is to be

12 feet by 17 feet with its floor at elevation 98.00. The pump room will be 17 feet by 25 feet. The floor of the pump room is to be at elevation 93.00 which will permit the pumps to be self-priming.

There will be four 8 inch centrifugal pumps, each direct connected to a 10 horse power alternating current motor. Each unit is to run at 1150 R.P.M. with a rated capacity of 1200 gallons per minute. The combined capacity of 3 of these units is to be 5.2 million gallons daily. All 4 units will have a combined capacity of 6.9 million gallons daily. The pumps are to work against a total head of 20.5 feet. The actual vertical lift will be 16.5 feet.

Four dosing tanks will be used. Since all the sewage to be treated on the trickling filter must first be passed through the dosing tanks the same rate of flow is assumed in the design of both the filter and the tanks. The trickling filter will be operating at full load for only a part of the time and therefore need be designed only for the average monthly rate occurring when the available dilution will probably be the lowest - that is in September or October. Therefore a rate of 4.0 million gallons daily is used in the design both of the trickling filter and of the dosing tanks. The maximum rate of flow will be 5.2 million gallons daily. The dosing tanks are to be right truncated pyramids whose elements make a 45 degree angle with the base. At the bottom the tanks are to be square, 8.2 feet on a side, and at the top they are to be 18.2 feet on a side. There is to be 5.0 feet of water in the tanks when full

giving each tank a capacity of 6950 gallons. The bottom of each dosing tank is to be set at an elevation 3.0 feet higher than the sprinkling nozzles. These tanks are designed for five minutes dosing and ten minutes resting. The rate of flow to each tank will be 1.55 cubic feet per second. Each tank is to be emptied through a 12 inch intermittent siphon. These dosing tanks are to be grouped together under the same roof. Space should be left for the construction of two more such tanks.

The pumps will raise the settled sewage to the dosing tanks, from which the sewage will be discharged intermittently to the trickling filter. The trickling filter is to be of 1 inch crushed rock placed 6.0 feet deep over a porous false floor. The filter is designed to operate at a rate of 1,200,000 gallons per acre per day. This rate is the equivalent of 124 gallons per cubic yard per day or of 3,070 persons per acre per foot in depth. 145,200 square feet (3.33 acres) will be required to treat 4 million gallons daily. This area is to be arranged in a rectangular shape. The sewage is to be applied intermittently to this filter through Taylor circular spray sprinkling nozzles. The head on the nozzles is to vary from 5.0 feet to zero. In laying out the shape of the trickling filter bed provision was made for the use of half nozzles in the marginal rows and for a margin of two feet between these rows of half nozzles and the edge of the filter. If 15 rows of 44 whole nozzles and 2 rows of 44 half nozzles are used an area of 145,000. square feet will be served. Six hundred sixty whole nozzles will be required. These nozzles are to be set 6 inches above the surface of the filter.

Each dosing tank applies sewage to a particular quarter of the trickling filter area. The layout of the distribution system is shown on Plate 11.

The effluent is removed from the trickling filter through three main underdrains running lengthwise of the filter on a slope of 0.2 per cent. The short lateral drains are built on a slope of 1 per cent. The floor of the filter is divided into 168 small drainage areas each served by a short lateral drain. The layout of the collection system is shown in Plate 11. The head lost through the collection system is 3.90 feet.

On the general plan an area 174 feet by 217 feet is reserved for a future addition to the sprinkling filter installation.

The effluent from the trickling filters is to be passed through two secondary sedimentation tanks operated in parallel. These tanks are designed for an average rate of flow of four million gallons daily and a retention period of three hours. Six thousand cubic feet of sludge storage is provided for. This gives approximately six weeks sludge storage at a rate of accumulation of 33 feet of sludge per million gallons of filter effluent. The tanks are to be 8.0 feet deep exclusive of sludge storage which is provided for in the bottom which slopes to a central sump. The tanks are 46 feet wide, 61 feet long and are each divided by one longitudinal baffle. The average velocity of flow is .68 feet per minute. On the general plan room is left for a tank 25 feet wide to be installed when needed.

The effluent from the secondary sedimentation tanks should be of a quality such as to require no diluting water.

Elevations at the plant are :

	El.	Head lost
Invert at Screen Chamber	95.00	
High Water Line at Screen Chamber	97.25	2.25
Imhoff Tank	95.00	0.50
Suction Well	94.50	-16.50
Dosing Tank (full)	111.00	8.00
Nozzles of Trickling Filter	103.00	10.50
Flow Line Main Under-Drain	92.50	.50
" Secondary Tank	92.00	
Salt Fork		
Normal Low Water	86.3	
High Water	97.0	
Surface of Sludge Drying Beds	96.3	
" " Trickling Filter	102.5	
Pump Room Floor	93.0	
Floor of Suction Well	87.5	
Office Floor	98.0	

The secondary tanks will be flooded at intervals and the Imhoff tanks will be flooded more rarely.

Plate 10 shows the general layout of the treatment plant. Plate 12 shows a plan of the Imhoff tanks, pumphouse and dosing tanks and shows a section through this part of the plant. Plate 13 shows part of the sludge drying beds and shows the secondary tanks. Plate 11 shows the distribution system and the collection system of the trickling filter. Plate 14 shows a section of a portion of the trickling filter.

It is planned to provide a residence at the plant for the operator in charge. Somewhat more than an acre of ground is left for this purpose.

The following is an estimate of the probable cost of a sewage treatment plant such as has been described. An

attempt has been made to bring published unit construction costs up to date by the use of index numbers. An index number of 115 has been taken for the first part of 1916.* Engineering and Contracting gives 152 as the index to the same base, for March 1922. An estimating prices from 1916 figures a ratio of 1.32 has been used. Most of the unit prices given below have been estimated from data in "American Sewerage Practice". Vol.III. Prices on pumping machinery were estimated from data furnished by the manufacturers.

FIRST COST OF PLANT.

Imhoff Tanks: 6.1 million gallons daily capacity at $13,500	$82,000.
Pumping Equipment: Four 1200 gallon per minute, 10-horsepower units at $1450	5,800.
Sprinkling Filters: 32, 300 cubic yards at $6.00 (or at $58,200 per acre)	194,000.
Secondary Sedimentation Tanks, 51,000 cubicfeet at .39¢	19,400.
Sludge-drying Beds (1946) .72 acre at $4,570	3,300.
Screen Chamber	700.
Dosing Tanks and Apparatus, 4 million gallon daily average capacity at $1,940	7,800.
Pump House	2,000.
Pipe Lines	6,200.
Supt's. Residence	4,500.
Contingencies 10.6 per cent of total	43,600.
Administration 10 per cent of total	40,700.
	$410,000

*"Sewerage and Sewage Disposal", Metcalf and Eddy, p.VII.

ANNUAL OPERATING COST.

Pumping 976 million gallons at $5.40 for electricity alone	$5,270.
Superintendent, 12 months at $133.33	1,600.
Laborers at $100.00; one for 8 mo; one for 10mo.	1,800.
Extra labor, 120 man-days at $3.50	420.
Maintenance of buildings and grounds	1,000.
Lighting, heating and water supply	250.
Plant supplies (oil, etc.,)	500.
Plant maintenance	900.
Contingencies 9.7 per cent of total	1,260.
	$13,000

A sewage treatment plant as outlined in a preliminary way in this chapter would solve the sewage disposal problem for the cities of Champaign and Urbana. While the cost of the proposed structure is not low it is well below the limit of the sum which the voters of the community are able to authorize the Urbana and Champaign Sanitary District to spend. When the question of a bond issue for the construction of sewage treatment works comes up, the real question at issue will be not whether such disposal works are to be constructed, but rather, whether such disposal works are to be constructed now or a few years in the future under the compulsion of some higher governmental authority.

TABLES.

PLATES.

TABLE I.

TYPICAL ANALYSES OF WATER.

	(1) Tap Water p.p.m.	(2) Salt Fork p.p.m.
Turbidity	12.	
Color	15.	
Residue on evaporation	400.	518.
Chlorine in Chlorides	1.	8.
Oxygen Consumed	4.9	4.3
NH_3 Nitrogen	2.8	.080
Albuminoid Nitrogen	.12	.192
Nitrite "	.02	.022
Alkalinity Methyl Orange	362.	246.
Dissolved Oxygen		6.46
Per Cent Saturation		70.
Relative Stability - Per Cent		84.

(1) As supplied by the Champaign and Urbana Water Co. The University supply is of practically the same quality as that for Champaign and Urbana except for an added iron content of about 2 p.p.m.

(2) Mean of analyses of two samples taken on Oct.1,1917 at two different stations above junction with the Boneyard. Estimated flow (exclusive of sewage) below Champaign sewer outlet was 1,500,000 gallons per day. From report on "Condition of Salt Fork in the Vicinity of Urbana".Oct.1917, G.C.Habermeyer,Engineer of the State Water Survey.
Temp 68°F

TABLE II.

STREAM RUNOFF.

Month	Sangamon near Monticello (1)	Vermilion near Danville (2)	Estimate for Salt Fork at Sewer Outlet (3)	(4)
	Second -feet per square mile			Thousand Gallons Daily
Feb. 1908	3.44			169,000
Mar.	2.51			123,400
Apr.	2.04			100,200
May	6.56			322,000
June	.473			23,300
July	.106			5,210
Aug.	.024			1,178
Sept.	.012			589
Oct.	.013			638
Nov.	.024			1,178
Dec.	.026			1,277
Jan. 1909	.031			1,523
Feb.	1.69			83,000
Mar.	.815			40,000
Apr.	2.20			108,000
May	1.34			65,800
June	1.01			49,600
July	1.73			85,000
Aug.	.074			3,630
Sept.	.029			1,424
Oct.	.032			1,571
Nov.	.198			9,720
Dec.	.184			9,030
Jan. 1910	1.32			64,800
Feb.	.600			29,500
Mar.	.671			32,900
Apr.	.169			8,300
May	.705			34,600
June	.331			16,240
July	.112			5,500
Aug.	.039			1,914
Sept.	.163			8,000
Oct.	.078			3,830
Nov.	.039			1,914
Dec.	.157			7,710

TABLE II. CONT.

STREAM RUNOFF.

Month	Sangamon near Monticello (1)	Vermilion near Danville (2)	Estimate for Salt Fork at Sewer Outlet. (3)	(4) Thousand Gallons Daily
	Second-feet per square mile			
Apr. 1915	.161	.148	.154	7,550
May	.156	.188	.172	8,450
June	.209	.484	.346	17,000
July	.416	.712	.564	27,700
Aug.	2.56	1.97	2.26	111,000
Sept.	1.03	.496	.763	37,500
Oct.	.260	.256	.258	12,670
Nov.	.119	.118	.118	5,790
Dec.	.155	.192	.173	8,500
Jan. 1916	2.60	3.12	2.86	140,400
Feb.	2.11	1.36	1.73	84,900
Mar.	.987	.497	.742	36,400
Apr.	.685	.645	.665	32,700
May	.516	.930	.723	35,500
June	.416	.659	.537	26,300
July	.081	.119	.100	4,920
Aug.	.022	.021	.021	1,032
Sept.	.014	.020	.017	835
Oct.	.021	.030	.025	1,227
Nov.	.027	.033	.030	1,473
Dec.	.029	.106	.067	3,290
Jan. 1917	.034	.153	.093	4,570
Feb.	.037	.044	.040	1,964
Mar.	.691	.984	.837	41,200
Apr.	.582	.672	.627	30,700
May	.354	.938	.646	31,700
June	1.96	2.38	2.17	106,600
July	.273	.372	.322	15,800
Aug.	.276	.137	.206	10,120
Sept.	.103	.098	.100	4,920
Oct.	.029			1,423
Nov.	.048			2,350
Dec.	.035			1,720

TABLE II. CONT.

STREAM RUNOFF.

Month	Sangamon near Monticello (1)	Vermilion near Danville (2)	Estimate for Salt Fork at Sewer Outlet. (3)	(4) Thousand Gallons Daily
	Second-feet per square mile			
Jan. 1911	1.00			49,200
Feb.	.584			28,700
Mar.	.484			23,800
Apr.	1.22			59,900
May	.322			15,800
June	.054			2,650
July	.014			687
Aug.	.0088			432
Sept.	.589			28,900
Oct.	.951			46,700
Nov.	1.33			65,300
Dec.	.909			44,700
Jan. 1912	.564			27,700
Feb.	.840			41,200
Mar.	3.89			191,000
Apr.	2.35			115,400
May	1.93			94,800
June	.264			12,960
July	.575			28,300
Aug.	.139			6,920
Sept.	.037			1,817
Oct.	-----			-------
Nov.	.320			15,700
Dec.	.104			5,110
July 1914	.014			687
Aug.	.0065			319
Sept.	.012			589
Oct.	.0080			393
Nov.	.010	.015	.012	589
Dec.	.015	.021	.018	884
Jan. 1915	.014	.023	.018	884
Feb.	.842	.702	.772	37,900
Mar.	.161	.255	.208	10,220

TABLE II. CONT.

STREAM RUNOFF.

Month	Sangamon near Monticello (1)	Vermilion near Da nville (2)	Estimate for Salt Fork at Sewer Outlet. (3)	(4)
	Second-feet per square mile			Thousand Gallons Daily
Jan. 1918	.017			835
Feb.	2.16			106,000
Mar.	.275			13,500
Apr.	1.13			55,500
May	1.14			56,000
June	.667			32,700
July	.778			38,200
Aug.	.055			2,700
Sept.	.431			21,100

(1) Mean monthly discharge -from U. S. G. S. water supply papers 265, 285, 305, 325, 405, 435, 455, 475. Drainage area 550 sq. mi.

(2) Water supply papers 403, 433, 453. Dra inage area 1280 sq. mi.

(3) The a verage of (1) and (2).

(4) Based on drainage area 76 sq. mi.

TABLE III.

ESTIMATE OF MINIMUM FLOW IN SALT FORK
Based on 109 Months of Record.

Thousand Gallons Daily	Months Occurring	Per Cent of Time
300	109	100.0
350	108	99.2
400	107	98.2
450	106	97.3
500	106	97.3
550	106	97.3
600	103	94.5
650	102	93.6
700	100	91.8
750	100	91.8
800	100	91.8
850	98	89.9
5,000	72	66.1
10,000	58	53.2
20,000	49	45.0
30,000	39	35.8
60,000	18	16.5
90,000	12	11.0
120,000	5	4.6
150,000	3	2.8
180,000	2	1.8
210,000	1	.9
240,000	1	.9
270,000	1	.9
300,000	1	.9

TABLE IV.

ILLINOIS STATE WATER SURVEY, TABLE X., AVERAGE ANALYSES OF 234 SAMPLES FROM MAY 3 to SEPTEMBER 3,1921. (Sewage Treated 9466,000 gallons).

Parts per Million

	Screened Sewages				Effluents	
	Max.	Min.	Av.	Corrected* Average	Average	Corrected* Average
Settleable Solids (1 hr. Imhoff cone %)	0.47	0.13	0.26	0.26		
Turbidity	447.	129.	237.	234.	68.	48.
Residue on Evaporation	1560.	840.	997.	1007.	863	828.
Chlorides	195.	62.	113.	109.	114	107
Alkalinity(Methyl Orange)	493.	237.	420	405	405	398
Oxygen Consumed(from $KMnO_4$ 1/2hr. at 100°)	103	25	59.3	58.	35.8	33.0
Free NH_3	24.6	7.2	16.4	15.5	14.8	15.1
Albuminoid Ammonia	11.3	0.9	4.2	4.2	2.2	1.7
Total Organic Nitrogen	40.0	4.0	12.3	12.1	7.9	5.7
Nitrate "	14.6	0.1	1.4	2.1	0.69	0.90
Nitrite "	0.59	0.0	0.15	0.26	0.10	0.10
Relative Stability(Methylene Blue)					(8 1/2 days)	43%

* The corrected average excludes the days from June 16 to July 31 during which sludge was allowed to overflow tank No.2 with the effluent.

TABLE V.

GROUPED SEWAGE ANALYSES

Set Number	Date 1921	Number of Days (1)	Rate of Flow Million Gallons Daily	Rate of Flow % of Mean (2)	Strength Index	Settleable Solids %	Turbidity Parts per Million	Alkalinity Parts per Million
1	May 3 to 13	11	1.86	138	93	.20	225	367
2	" 14 to 21	8	1.30	96	141	.31	221	422
3	" 22 toJune 1	11	1.95	144	56	.24	199	333
4	June 2 to 15	14	1.46	108	127	.23	201	401
5	" 16 to 30	15	1.00	74	224	.39	249	443
6	July 1 to 10	10	.91	67	244	.24	231	449
7	" 15 to 31	17	.88	65	182	.21	242	437
8	Aug. 1 to 15	15	.91	67	309	.28	243	422
9	" 16 to 21	6	.73	54	523	.29	262	463
10	" 22 toSept.1	11	.89	65	267	.26	302	438
11	Sept.2 to 20	19	1.07	79	180	.22	264	433
12	" 21 to 28	8	1.09	81	181	-	281	461
13	" 29 to Oct.6	8	1.24	91	174	-	279	474
14	Oct. 7 to 16	10	1.15	85	192	-	263	461
15	" 16 to 31	15	1.21	90	315	-	297	475
Total		168						

(1) The number of composite daily samples averaged for the set.
(2) Per cent of mean rate of flow for the 306 days of record.

TABLE V. Cont.

GROUPED SEWAGE ANALYSES

Parts Per Million

Set Number	Oxygen Consumed	Total Residue	Free Ammonia	Albuminoid Ammonia	Organic Nitrogen	Nitrate	Nitrite	Chloride
1	51	940	12.5	3.6	9.6	2.9	.47	88
2	56	999	17.0	4.4	9.2	2.1	.32	96
3	42	962	9.3	2.0	7.1	6.4	.82	85
4	54	903	12.3	3.8	11.1	2.2	.20	111
5	65	991	17.0	4.4	12.5	1.0	.07	118
6	62	986	16.5	4.5	13.4	0.6	.05	134
7	56	964	20.0	3.6	9.5	0.5	.04	114
8	69	1021	18.7	5.2	13.7	0.8	.08	118
9	84	1162	21.0	5.9	21.6	0.8	.02	126
10	54	1047	19.3	4.7	15.0	0.7	.04	138
11	55	991	14.6	3.5	13.0	1.14	.12	105
12	44	991	20.6	1.7	14.3	0.7	.04	119
13	50	963	22.8	3.7	12.3	0.6	.05	103
14	55	961	23.4	4.3	12.5	1.0	.09	101
15	61	1027	26.4	4.5	14.2	0.9	.06	124

TABLE VI.

DAY vs. NIGHT SEWAGE

Date	9 A.M.-4 P.M. (1) NO_3	(2) Turbidity	% Settling Solids	5P.M.-12 P.M. (1) NO_3	(2) Turbidity	% Settling Solids	1 A.M.-3 A.M. NO_3	Turbidity	Quality of Sewage.% Settling Solids
May 22	1.3	310	.60	1.3	310.	.25	2.5	65.	.08
" 23		220	.70		220	.20		50	.08
" 24		240	.70		240	.20		65	.07
" 25	1.3	450	.55	1.3	450	.60	12.0	110	.08
" 26	14.0	230	.25	14.0	230	.11	16.0	60	.05
" 27	10.0	210	.20	10.0	210	.18	10.0	65	.10
" 28	6.0	230	.30	6.0	230	.18	10.0	80	.05
Average	6.5	270	.47	6.5	270	.25	10.1	71	.07
Aug. 16	0.5	300	.50	0.5	300	.25	1.0	100	.05
" 17	0.7	400	.50	0.7	400	.17	0.5	70	.10
" 18	1.3	460	1.00	1.3	460	.25	0.1	95	.12
" 19	1.5	350	.40	1.5	350	.25			
" 20	0.7	250	.50	0.7	250	.35	0.7	100	.10
" 21	1.3	300	.30	1.3	300	.20	0.7	120	.15
Average	1.0	343	.53	1.0	343	.24	0.6	97	.10

(1) Composite Sample
(2) " "

Night sewage (1:00 to 8:00 A.M.) is about 1/4 as strong as day sewage (9:00 A.M. to 12:00P.M.) and is about 1/3 as strong as the composite sewage for the 24 hours.

TABLE VII.
POPULATION.

Year	Champaign & Urbana	Rockford	S. Bend Indiana	Peoria	Decatur	Dan-ville	Univ. of Ill.
1860	3,765	6,979	3,803	14,045	3,839	1,632	
1870	6,902	11,049	7,206	22,849	7,161	4,751	
1880	8,045	13,129	13,280	29,259	9,547	7,733	
1890	9,350	23,584	21,819	41,024	16,841	11,491	
1900	14,826	31,051	35,999	56,100	20,754	16,354	
1910	20,666	45,401	53,684	66,950	31,140	27,871	
1920	26,103	65,651	70,983	76,121	43,818	33,750	7,839
1936	41,600						19,000
1946	51,200						21,000
1950	55,100						
1850		2,093	1,652	5,095		736	
Year when population= 26,103	1920	1893	1893	1875	1905	1908	

(Estimated annual increase in population = 967 for Champaign and Urbana.)

TABLE VIII.

Net Attendance for Each Academic Year in the Champaign and Urbana Departments of the University. From a Tabulation in the Office of the Supervising Architect.

Year	Attendance	Year	Attendance
1869-70	180	1897	699
71	277	98	835
72	434	99	973
73	400	1899-1900	1156
74	405	01	1341
75	373	02	1549
76	383	03	1836
77	274	04	2188
78	256	05	2376
79	276	06	2616
80	303	07	2866
81	302	08	3223
82	281	09	3463
83	282	1910	3676
84	245	11	3793
85	273	12	3983
86	276	13	4002
87	252	14	4338
88	274	15	4928
89	296	16	5270
90	356	17	5610
91	387	18	4504
92	420	19	6123
93	518	20	7839
94	552	1920-1921	7989
95	633	1921-1922	8714
96	682		

TABLE IX.

Champaign Sewage

Rate of Flow at the Plant on Typical Days
in Thousand Gallons per Day.

Time	S	W	M
A.M.			
8:30-9:30	972.	1203	875
9:30-10:30	1080.	1320	1110
10:30=11:30	1110	1330	1170
11:30-12:30	1040	1360	1140
P.M.			
12:30-1:30	972	1230	1100
1:30-2:30	1010	1230	945
2:30-3:30	972	1330	952
3:30-4:30	1040	1200	1070
4:30-5:30	1010	1200	1080
5:30-6:30	1110	1200	914
6:30-7:30	1110	1200	883
7:30-8:30	972	1200	828
8:30-9:30	910	1140	770
9:30-10:30	850	1140	740
10:30-11:30	702	800	742
11:30-12:30	730	890	643
A.M.			
12:30-1:30	702	860	640
1:30-2:30	640	740	643
2:30-3:30	498	620	677
3:30-4:30	498	570	1190
4:30-5:30	475	570	1440
5:30-6:30	402	570	1730
6:30-7:30	452	670	2330
7:30-8:30	610	830	2930
			2620
Mean	828	1015	1166

S = Typical summer day, Wed. July 13,1921
W = " winter " " Jan.12,1920
M = Sept.2,1921. Shows effect of rain. Only a trace of rain was recorded for the day.

NOTE: The minimum recorded rate of flow for one hour = 300,000 gallons per day on August 6,1921. The maximum recorded hourly rate is shown under M.

TABLE X.

WEEKLY AVERAGES OF HOURLY FLOW IN THE CHAMPAIGN SEWER.

Unit Rate given in 1000-Gal.per hour.

Day / Date / Period	Saturday Jan. 1 to Jan.7	Saturday Feb.19 to Feb.26	Monday Mar.21 to Mar.28	Monday May 16 to May 23	Monday June 6 to June 13	Saturday June 25 to July 2
AM 8:30-9:30	49.0	52.5	80.5	62.5	67.5	43.5
9:30-10:30	58.5	59.5	83.0	70.5	72.5	50.0
10:30-11-30	58.5	60.0	84.0	70.0	73.5	50.0
11:30-12:30	59.0	58.5	84.0	68.0	74.0	50.0
PM12:30-1:30	57.0	58.0	83.0	67.0	75.5	49.0
1:30-2:30	56.0	55.5	83.5	64.0	70.5	44.5
2:30-3:30	58.0	57.5	82.5	64.5	71.0	43.5
3:30-4:30	56.5	56.0	81.5	64.5	70.0	49.0
4:30-5:30	56.5	54.0	81.5	62.5	67.0	48.0
5:30-6:30	55.0	53.0	81.5	60.0	64.0	45.0
6:30-7:30	54.0	53.0	81.0	62.0	63.0	43.0
7:30-8:30	53.0	51.0	77.5	58.0	59.5	43.0
8:30-9:30	53.0	47.5	76.5	56.5	57.0	37.5
9:30-10:30	51.5	46.5	75.5	53.0	53.5	37.5
10:30-11:30	46.0	44.0	74.5	46.0	51.6	34.0
AM11:30-12:30	44.0	43.0	73.5	45.0	51.0	33.0
12:30-1:30	42.5	41.0	73.5	36.0	49.5	30.5
1:30-2:30	36.0	37.0	71.5	33.0	46.5	27.5
2:30-3:30	32.5	33.0	70.0	33.0	43.5	25.5
3:30 -4:30	30.0	29.0	70.0	29.0	42.5	25.0
4:30-5:30	29.5	28.5	69.5	33.0	40.5	22.0
5:30-6:30	29.0	28.5	74.5	37.5	40.0	21.0
6:30-7:30	31.0	31.0	74.5	36.5	42.0	26.5
7:30-8:30	32.0	39.0	78.0	41.0	51.0	33.5

TABLE X. Cont.

Day Date Period	Wednesday July 20 to July 27	Tuesday Aug. 3 to Aug. 10	Tuesday Aug.16 to Aug.23	Friday Sept.2 to Sept.9	Saturday Nov.17 to Nov.23	Wednesday, Dec Dec.7 to Dec.14
AM 8:30-9:30	36.5	37.0	35.0	62.5	88.0	73.0
9:30-10:30	44.0	40.0	45.5	62.5	91.5	79.0
10:30-11:30	46.0	49.0	49.0	62.5	91.0	82.5
11:30-12:30	45.0	46.5	46.0	60.0	90.5	82.0
PM12:30-1:30	44.5	43.5	43.0	57.5	89.0	81.0
1:30-2:30	42.0	43.0	40.0	57.0	87.5	82.0
2:30-3:30	44.0	42.0	39.0	56.0	87.0	82.5
3:30-4:30	45.0	42.0	38.5	54.5	86.0	81.5
4:30-5:30	44.0	41.5	38.0	53.0	85.5	79.0
5:30-6:30	41.0	41.0	37.5	51.0	85.0	79.5
6:30-7:30	39.5	39.0	34.5	49.0	83.5	80.0
7:30-8:30	36.0	38.0	31.0	48.0	82.0	80.0
8:30-9:30	34.0	36.0	29.5	46.5	82.0	79.5
9:30-10:30	33.5	34.0	28.0	45.5	82.5	78.0
10:30-11:30	30.0	31.0	26.0	42.0	82.5	76.5
AM11:30-12:30	27.5	28.5	24.5	40.5	82.5	76.0
1:30-2:30	24.0	27.0	22.0	38.5	81.0	75.0
2:30-3:30	23.5	24.0	20.0	37.5	80.5	71.0
3:30-4:30	21.5	21.5	19.5	36.5	80.0	68.5
4:30-5:30	20.5	20.0	19.0	38.5	79.0	65.5
5:30-6:30	19.5	19.0	20.5	44.5	79.0	63.0
6:30-7:30	18.5	21.5	24.5	46.0	79.0	58.0
7:30-8:30	18.0	24.0	26.0	48.0	82.0	53.5
8:30-9:30	24.5	27.0	28.0	56.0	84.5	60.5

TABLE XI.

MEAN RATE OF FLOW IN THOUSAND GALLON UNITS DAILY FOR TYPICAL WEEKS.

Day	Champaign's Sewage						Corrected University Pumpage		
	July 10-16 inc.	Rfl.	Feb. 20-26 inc.	Rfl.	May 25-31 inc.	Rfl.	Jan. 10-16	Feb. 20-26	May 25-31
Sun.									
Mon.									
Tues.									
Wed.					2150	1.10			473
Thurs.					2544	3.60			293
Fri.		.26			2453	.06			460
Sat.					2185	.01			448
Sun.	755		1038		2082		337	461	381
Mon.	865		1151		2117		546	319	352
Tues.	856		1162	.01	2130		798	531	709
Wed.	827		1138				490	450	
Thurs.	877		1113				525	381	
Fri.	790		1104				291	466	
Sat.	844		1096				783	471	
Mean	831		1115		2237				

Rfl = Rainfall during day.

TABLE XII.

Champaign 1921

MEAN WEEKLY SEWAGE FLOWS IN THOUSAND GALLONS DAILY.

Week Ending	Flow	Rainfall	Week Ending	Flow	Rainfall.
Jan. 1	1315	.02	July 2	910	.32
" 8	1102	.17	" 9	922	.26
" 15	1012	.13	" 16	827	
" 22	1025	.50	" 23	862	.92
" 29	1076	.22	" 30	917	1.28
Feb. 5	1183	.71	Aug. 6	853	1.20
" 12	1260	.33	" 13	962	1.94
" 19	1147		" 20	778	.14
" 26	1114	.01	" 27	877	.98
Mar. 5	1112	.35	Sept. 3	991	1.17
" 12	1614	2.22	" 10	1060	1.74
" 19	1925	.10	" 17	978	.88
" 26	1816	1.92	" 24	1120	.59
Apr. 2	1887	1.32	Oct. 1	1130	1.26
" 9	1904	.23	" 8	1230	.78
" 16		1.37	" 15	1100	
" 23		1.35	" 22	1280	.33
" 30		1.57	" 29	1140	1.05
May 7	2121	.10	Nov. 5	1080	.074
" 14	1650	.39	" 12		0.69
" 21	1285		" 19	2040	4.07
" 28	1857	4.77	"26	2070	.15
June 4	2030	.42	Dec. 3	2090	.31
" 11	1460	.36	" 10	1820	.01
" 18	1110	.69	" 17	1410	.71
" 25	1020	.57	" 24		
			" 31		

TABLE XIII.

WATER EXCHANGED BETWEEN THE CHAMPAIGN AND URBANA WATER COMPANY AND THE UNIVERSITY OF ILLINOIS.

(Part a)

Pumped by City to University

Date	Thousand Gallons
June 24,1920	54
August 15	208
October 10	242
November 7	242
January 2,1921	215
March 13	201

(Part b)

Pumped by University to City

May 18,1921	195
" 19	255
" 20	242
" 21	255
" 22	275
" 24	215
" 25	248
" 26	269
June 1	262
" 2	262
" 4	382
" 8	242
" 9	289
" 10	248
" 14	255
" 15	269
" 18	295
" 21	242
" 24	295
" 27	235
" 28	242
July 1	248
" 2	221
" 3	242
" 6	242
" 7	215
" 13	295
" 14	261
" 15	295
" 17	282
" 20	261
" 26	269
" 28	255
" 29	269

TABLE XIII. Cont.

(Part b.Cont.)
Pumped by University to City.

	Thousand Gallons
Sept.27,1921	255
" 29	369
" 30	235
Oct. 1	282
" 5	275
" 7	242
" 9	295
" 13	161
" 25	269
" 28	259
Nov. 2	269
" 4	248
" 5	242
" 11	295
" 14	289
" 15	269
" 22	208
" 30	175
Dec. 3	269
" 5	235
" 7	221
" 10	248
" 13	201
" 16	224
" 17	221
" 18	201
" 22	255
Jan. 3,1922	295
" 6	287
" 7	228
" 9	302
" 10	375
" 11	215
" 12	228
" 13	248
" 14	215

TABLE XIV.

CORRECTED RATE OF HOURLY PUMPAGE AT UNIVERSITY OF ILLINOIS ON WEDNESDAYS.

1921.

Time	March 9 Thousand Gallons Daily.	August 3 Thousand Gallons Daily.
6 to 7 A.M.	341	485
7	468	377
8	701	485
9	754	485
10	898	609
11	701	665
12 M	540	432
1 P.M.	521	432
2	521	557
3	573	503
4	573	485
5	665	485
6	521	360
7	412	485
8	432	468
9	396	485
10	341	432
11	341	288
12 M.N.	360	216
1 A.M.	324	252
2	324	252
3	341	252
4	341	233
5	324	233

TABLE XV.

UNIVERSITY OF ILLINOIS

MEAN WEEKLY PUMPAGE IN THOUSAND GALLONS DAILY.

Week Ending	Rate of Flow	Week Ending	Rate of Flow
January 1	326	July 2	628
" 8	410	" 9	585
" 15	430	" 16	660
" 22	424	" 23	525
" 29	422	" 30	592
February 5	414	August 6	424
" 12	428	" 13	428
" 19	380	" 20	366
" 26	440	" 27	381
March 5	474	September 3	416
" 12	472	" 10	357
" 19	472	" 17	395
" 26	444	" 24	437
April 2	453	October 1	572
" 9	493	" 8	537
" 16	481	" 15	533
" 23	487	" 22	472
" 30	482*	" 29	523
May 7	463*	November 5	566
"14	516*	" 12	515
"21	620*	" 19	552
"28	554	" 26	477
June 4	529	December 3	565
" 11	503	" 10	570
" 18	554	" 17	577
" 25	536	" 24	452
"		" 31	343
		1922	
		January 7	546
		" 14	642
		" 21	636
		" 28	635

Mean for year = 493.
Mean per student = 61.6 gallons daily

*Calculated from pumpage from well No.6 at the rate of 32,600 gallons per hour.

TABLE XVI.

MEAN WEEKLY USE OF WATER BY UNIVERSITY OF ILLINOIS

THE UNIVERSITY PUMPAGE CORRECTED FOR THE FLOW OF WATER TO AND FROM THE MAINS OF THE CHAMPAIGN AND URBANA WATER COMPANY.

Week Ending	Thousand Gallons Per Day	Week Ending	Thousand Gallons Per Day
Jan. 1	326	July 1	492
" 8	471	" 9	443
" 15	430	" 16	581
" 22	424	" 23	446
" 29	422	" 30	477
Feb. 5	414	Aug. 6	424
" 12	428	" 13	428
" 19	380	" 20	366
" 26	440	" 27	381
Mar. 5	474	Sept. 3	416
" 12	472	" 10	357
" 19	501	" 17	395
" 26	444	" 24	437
April 2	453	Oct. 1	408
" 9	493	" 8	464
" 16	481	" 15	468
" 23	487	" 22	472
" 30	482	" 29	448
May 7	463	Nov. 5	457
" 14	516	" 12	473
" 21	484	" 19	472
" 28	411	" 26	448
June 4	414	Dec. 3	501
" 11	391	" 10	469
" 18	438	" 17	485
" 25	459	" 24	388
		" 31	343
		1922	
		Jan. 7	463
		" 14	429

Mean = 444. Thousand gallons daily.

TABLE XVII.

DISTRIBUTION OF UNIVERSITY PUMPAGE.

University Buildings Connected to Champaign Sanitary Sewer.

	%*	Rate (1)
Vivarium		
Y.W.C.A.	.95	33.5
Union (part)	1.00e	
Armory	6.00e	
Horticulture	.03	1.0
Isolation Hospital	.50e	
Beef Cattle Buildings	3.00e	
Mumford's House	.54	18.8
Stock Judging Pavilion		
Dairy Barn & Milk-house	6.00e	
Gymnasium	5.87	206.6
Gym Annex	e	
Education	2.59	91.3
Botany Green House	1.17	41.3
Wood Shop		
Metal Shop	.01	.4
Electrical Engineering Lab.	.07	2.4
Power House		63.1 (2)
Locomotive Test Lab.		
Ceramics	1.56	54.8
Mining Lab.	.17	5.5
Transportation	12.50	439.6
Mechanical Engineering Lab.	.04	1.3
Unaccounted For	3.96	
Total	45.96	

Buildings Connected to Urbana Sewers.

Health Service		
A.M.Lab.		
Engineering Hall	.70	24.6
Physics	1.47	51.9
Library	e	
Administration	.94	33.1
University Hall	.93	32.9
Law		
Natural History	1.32	46.6
Chemistry	12.80	455.5
Woman's Bldg.	3.38	118.6
Lincoln	.98	34.5
Auditorium	e	
Agriculture	7.70	270.8
Agricultural Green House	.07	2.3
Smith Music	.82	28.9
Horse Barn	1.00e	
Imp.Barn	1.00e	
Genetics	.07	2.5

TABLE XVII. Cont.

DISTRIBUTION OF UNIVERSITY PUMPAGE

University Buildings connected to Urbana Sanitary Sewers.

	%	Rate
Farm Mechanics	.22	7.9
Agronomy	.05	1.7
Flower Green-House	.16	5.5
Horticulture Green-House	2.33	81.9
Unaccounted For	3.39	
Total	39.33	

The Totals are as Follows:

	Per Cent
Received by Champaign Sewers	45.96
" " Urbana "	39.33
Not received by Sanitary "	14.70
	99.99

(1) The mean rate of flow for the three weeks Feb.18, to March 11, expressed in thousand gallons per week.

(2) Boiler make-up.

e Percentage estimated (meter readings not available).

* The per cent of the total average.

TABLE XVIII.

CHAMPAIGN AND URBANA 1936 ESTIMATE.

MEAN WEEKLY SEWAGE FLOW

MILLION GALLONS DAILY.

Week Ending	1921 C.Flow	46.0% Use at U.of I.	Corrected C.Flow	294% Corrected C.Flow	203% Use at U.of I.	1936 Estimate
1921						
Jan.1	1.32	.15	1.17	3.44	.66	4.10
" 8	1.10	.22	.88	2.59	.96	3.55
" 15	1.01	.20	.81	2.38	.87	3.25
" 22	1.03	.20	.83	2.44	.86	3.30
" 29	1.08	.19	.89	2.62	.86	3.48
Feb.5	1.18	.19	.99	2.91	.84	3.75
" 12	1.26	.20	1.06	3.12	.87	3.99
" 19	1.15	.17	.98	2.88	.77	3.65
" 26	1.11	.20	.91	2.67	.89	3.56
Mar.5	1.11	.22	.89	2.62	.96	3.58
" 12	1.61	.22	1.39	4.08	.96	5.04
" 19	1.93	.83	1.70	5.00	1.02	6.02
" 26	1.82	.20	1.62	4.76	.90	5.66
Apr.2	1.89	.21	1.68	4.93	.92	5.85
" 9	1.90	.23	1.67	4.91	1.00	5.91
" 16	1.96	.22	1.74	5.12	.98	6.10
" 23	2.01	.22	1.79	5.27	.99	6.26
" 30	2.07	.22	1.85	5.43	.98	6.41
May 7	2.12	.21	1.91	5.62	.94	6.56
" 14	1.65	.24	1.41	4.14	1.05	5.19
" 21	1.29	.22	1.07	3.14	1.98	4.12
" 28	1.86	.19	1.67	4.91	.83	5.74
June 4	2.03	.19	1.84	5.41	.84	6.24
" 11	1.46	.18	1.28	3.76	.79	4.55
" 18	1.11	.20	.91	2.67	.89	3.56
" 25	1.02	.21	.81	2.38	1.93	3.31

C = Champaign
U.of I. = University

TABLE XVIII. Cont.
MEAN WEEKLY SEWAGE FLOW
MILLION GALLONS DAILY.

Week Ending	1921 C.Flow	46.0% Use at U.of.I.	Corrected C.Flow	294% Corrected C.Flow	203% Use at U.of I.	1936 Estimate
1921						
July 2	.91	.23	.68	2.00	1.00	3.00
" 9	.92	.20	.72	2.12	.90	3.02
" 16	.83	.27	.56	1.65	1.18	2.83
" 23	.86	.21	.65	1.91	.91	2.82
" 30	.92	.22	.70	2.06	.97	3.03
Aug. 6	.85	.20	.65	1.91	.86	2.77
" 13	.96	.20	.76	2.23	.87	3.10
" 20	.78	.17	.61	1.80	.74	2.54
"27	.88	.18	.70	2.06	.77	2.83
Sept.3	.99	.19	.80	2.35	.84	3.19
" 10	1.06	.16	.90	2.65	.73	3.38
" 17	.98	.18	.80	2.35	.80	3.15
" 24	1.12	.20	.92	2.71	.89	3.60
Oct. 1	1.13	.19	.94	2.77	.83	3.60
" 8	1.29	.21	1.08	3.17	.94	4.12
" 15	1.10	.22	.88	2.59	.95	3.54
" 22	1.28	.22	1.06	3.11	.96	4.07
" 29	1.14	.21	.93	2.73	.91	3.64
Nov. 5	1.09	.21	.88	2.59	.93	3.52
" 12	1.57	.22	1.35	3.97	.96	4.93
" 19	2.04	.22	1.82	5.35	.96	6.31
" 26	2.07	.21	1.86	5.47	.91	6.38
Dec. 3	2.09	.23	1.86	5.47	1.02	6.49
" 10	1.82	.22	1.60	4.70	.95	5.65
" 17	1.41	.22	1.19	3.50	.99	4.49
					Mean	4.28

Mean for. year

TABLE XIX.

CHAMPAIGN AND URBANA 1936 ESTIMATE

MEAN DAILY SEWAGE FLOW FOR TYPICAL WEEKS.

MILLION GALLONS DAILY.

Day	1921 C.Flow	46.0% Use at U.of I.	Corrected C. Flow	294% Corrected C.Flow	203% Use at U.of I.	1936 Estimate
			Dry Summer Week			
Sun.	.76	.16	.60	1.76	.68	2.44
Mon.	.87	.25	.62	1.82	1.11	2.93
Tues.	.86	.37	.49	1.44	1.62	3.06
Wed.	.83	.22	.61	1.79	.99	2.78
Thurs.	.88	.24	.64	1.88	1.07	2.95
Fri.	.79	.13	.66	1.94	.59	2.53
Sat.	.84	.36	.48	1.41	1.59	3.00
Mean	.83					2.81
			Dry Winter Week			
Sun.	1.04	.21	.83	2.44	.94	3.38
Mon.	1.15	.15	1.00	2.94	.65	3.59
Tues.	1.16	.24	.92	2.71	1.08	3.79
Wed.	1.14	.21	.93	2.73	.91	3.64
Thurs.	1.11	.18	.93	2.73	.77	3.50
Fri.	1.10	.21	.89	2.62	.95	3.57
Sat.	1.10	.22	.88	2.59	.96	3.55
Mean	1.12					3.57
			Wet Spring Week			
Wed.	2.15	.22	1.93	5.67	.96	6.63
Thurs.	2.54	.13	2.41	7.08	.59	7.67
Fri.	2.45	.21	2.24	6.58	.93	7.51
Sat.	2.19	.21	1.98	5.82	.91	6.73
Sun.	2.08	.18	1.90	5.58	.77	6.35
Mon.	2.12	.16	1.96	5.76	.72	6.48
Tues.	2.13	.33	1.80	5.29	1.43	6.72
Mean	2.24					6.86

C = Champaign
U. of I. = University

TABLE XX.

CHAMPAIGN AND URBANA 1936 ESTIMATE.

HOURLY SEWAGE FLOW FOR TYPICAL DRY SUMMER'S DAY. MILLION GALLONS DAILY.

1921 C. Flow	46% Use at U.of I.	Corrected C.Flow 1921	Champaign Time	Champaign 179% 1921 Flow	Urbana Time	Urbana 115% C.Flow	Uni. of Ill. Time	Uni. of Ill. 203% Use 1921	1936
.97	.17	.80	9:00	1.43	7.9	.92	8.1	.99	3.21
1.08	.22	.86	10.	1.54	8.9	.99	9.1	.77	3.00
1.11	.22	.89	11	1.59	9.9	1.02	10.1	.99	2.93
1.04	.28	.76	12M	1.36	10.9	.87	11.1	.99	2.85
.97	.31	.66	1:00	1.18	11.9	.76	0.1	1.24	3.46
1.01	.20	.81	2PM	1.45	0.9	.93	1.1	1.35	3.28
.97	.20	.77	3	1.38	1.9	.89	2.1	.88	3.17
1.04	.26	.78	4	1.40	2.9	.90	3.1	.88	3.42
1.01	.23	.78	5	1.40	3.9	.90	4.1	1.13	3.45
1.11	.22	.89	6	1.59	4.9	1.02	5.1	1.02	3.58
1.11	.22	.89	7	1.59	5.9	1.02	6.1	.99	3.47
.97	.17	.80	8	1.43	6.9	.92	7.1	.99	2.99
.91	.22	.69	9	1.23	7.9	.79	8.1	.73	2.92
.85	.22	.63	10	1.13	8.9	.73	9.1	.99	2.65
.70	.22	.48	11	.86	9.9	.55	10.1	.95	2.47
.73	.20	.53	12:00	.95	10.9	.61	11.1	.99	2.50
.70	.13	.57	1A.M.	1.02	11.9	.66	0.1	.88	2.23
.64	.10	.54	2	.97	0.9	.62	1.1	.58	1.87
.50	.12	.38	3	.68	1.9	.44	2.1	.44	1.63
.50	.12	.38	4	.68	2.9	.44	3.1	.51	1.58
.48	.12	.36	5	.65	3.9	.41	4.1	.51	1.50
.40	.11	.29	6	.52	4.9	.33	5.1	.51	1.38
.45	.11	.34	7	.61	5.9	.39	6.1	.47	1.51
.61	.22	.39	8AM	.70	6.9	.45	7.1	.47	2.57

Time = Time of arrival at treatment plant.
C = Champaign
U.of I. = University.
1936 = Estimated rate of flow at plant in 1936 for hour listed as "time" for Champaign.

TABLE XX. Cont.

HOURLY SEWAGE FLOW FOR TYPICAL DRY WINTER DAY.
MILLION GALLONS DAILY.

1921 C. Flow	46% Use at U. of I.	Corrected C.Flow 1921	Champaign Time	Champaign 179% 1921 Flow	Urbana Time	Urbana 115% C.Flow	Uni.of Ill. Time	Uni.of Ill. 203% Use 1921	1936
1.20	.22	.98	9.00	1.76	7.9	1.13	8.1	.69	3.83
1.32	.32	1.00	10	1.79	8.9	1.15	9.1	.95	4.28
1.33	.35	.98	11	1.76	9.9	1.13	10.1	1.42	4.28
1.26	.41	.85	12M	1.52	10.9	.98	11.1	1.53	4.35
1.23	.32	.91	1	1.63	11.9	1.05	0.1	1.82	4.25
1.23	.25	.98	2	1.76	0.9	1.13	1.1	1.42	4.13
1.33	.24	1.09	3	1.95	1.9	1.25	2.1	1.10	4.10
1.20	.24	.96	4	1.72	2.9	1.11	3.1	1.06	3.86
1.20	.26	.94	5	1.68	3.9	1.08	4.1	1.06	3.91
1.20	.26	.94	6PM	1.68	4.9	1.08	5.1	1.16	3.88
1.20	.31	.89	7	1.59	5.9	1.02	6.1	1.16	4.03
1.20	.24	.96	8	1.72	6.9	1.11	7.1	1.35	3.89
1.14	.19	.95	9	1.70	7.9	1.09	8.1	1.06	3.61
1.14	.20	.94	10	1.68	8.9	1.08	9.1	.84	3.30
.80	.18	.62	11	1.11	9.9	.71	10.1	.88	2.76
.89	.16	.73	12MN	1.31	10.9	.84	11.1	.80	2.79
.86	.16	.70	1	1.25	11.9	.80	0.1	.69	2.58
.74	.17	.57	2	1.02	0.9	0.66	1.1	.69	2.27
.62	.15	.47	3	.84	1.9	.54	2.1	.73	2.00
.57	.15	.42	4	.75	2.9	.48	3.1	.66	1.87
.57	.16	.41	5	.73	3.9	.47	4.1	.66	1.90
.57	.16	.41	6	.73	4.9	.47	5.1	.69	2.05
.67	.15	.52	7	.93	5.9	.60	6.1	.69	2.11
.83	.16	.67	8:00	1.20	6.9	.77	7.1	.66	3.03

Mean = 3.31

TABLE XX. Cont.

HOURLY SEWAGE FLOW FOR A RAINY DAY. (3)

MILLION GALLONS DAILY.

1921 C. Flow	46% of Use at U.of I.	Corrected C.Flow	Champaign Time	179% 1921 Flow	Urbana Time	115% C.Flow	1936
.88	.22	.66	9:00	1.18	7.9	.76	3.03
1.10	.32	.78	10	1.40	8.9	.90	3.76
1.17	.35	.82	11	1.47	9.9	.94	3.84
1.14	.41	.73	12M	1.31	10.9	.84	4.03
1.10	.32	.78	1	1.40	11.9	.90	3.63
.95	.25	.70	2	1.25	0.9	.81	3.17
.95	.24	.71	3	1.27	1.9	.82	3.28
1.07	.24	.83	4	1.49	2.9	.95	3.49
1.08	.26	.82	5	1.47	3.9	.94	3.38
.91	.26	.65	6PM	1.16	4.9	.75	2.98
.88	.31	.57	7	1.02	5.9	.66	3.05
.83	.24	.59	8	1.06	6.9	.68	2.79
.77	.19	.58	9	1.04	7.9	.67	2.50
.74	.20	.54	10	.97	8.9	.62	2.49
.74	.18	.56	11	1.00	9.9	.64	2.35
.64	.16	.48	12MN	.86	10.9	.55	2.10
.64	.16	.48	1	.86	11.9	.55	2.09
.64	.17	.47	2	.84	0.9	.54	2.18
.68	.15	.53	3	.95	1.9	.61	2.81
1.19	.15	1.04	4	1.86	2.9	1.20	3.99
1.44	.16	1.28	5	2.31	3.9	1.47	4.81
1.73	.16	1.57	6	2.81	4.9	1.81	6.01
2.33	.15	2.18	7	3.90	5.9	2.51	7.75
2.93	.16	2.77	8	4.97	6.9	3.19	8.42
2.62	.22	2.40		4.30	7.9	2.76	7.58

Mean = 3.82

(3) For a rainy day the increment from the University is taken to be the same as for a dry winter day.

TABLE XXI.

MEAN MONTHLY AIR TEMPERATURES AT URBANA, ILL.

Degrees Fahrenheit.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1911	30.1	33.2	39.6	48.9	68.2	74.9	76.3	73.0	68.4	52.0	34.7	33.6
1912	14.1	21.7	30.4	51.1	64.0	67.6	74.3	71.4	66.5	54.7	41.2	32.3
1913	30.8	25.7	36.7	52.4	65.5	76.8	80.4	79.2	66.7	52.9	47.4	39.5
1914	33.3	20.9	38.1	52.6	67.3	76.9	81.0	76.4	66.8	58.1	43.8	22.4
1915	23.7	35.9	35.4	59.3	60.5	70.6	74.1	67.4	68.0	56.3	44.2	29.0
1916	29.7	26.5	37.3	50.6	64.0	67.9	82.3	78.2	65.2	54.4	43.4	27.6
1917	28.0	23.4	41.3	48.9	57.5	69.2	75.9	71.8	64.3	46.0	42.7	21.1
1918	12.0	29.9	47.1	47.6	68.5	71.1	75.0	79.1	59.2	57.3	41.6	38.2
1919	31.2	31.5	42.0	53.2	60.8	75.5	81.3	73.9	70.5	58.4	39.1	23.9
1920	20.9	28.7	41.2	45.1	62.3	73.6	75.6	72.8	68.9	59.9	39.8	31.7
Mean	25.4	27.7	38.8	51.0	63.9	72.4	77.6	74.3	66.5	55.0	41.8	29.9

Mean temperature for week preceding Oct. 1,1917 (when Salt Fork samples were taken) was 61.0°F Temperature on October 1,1917 was 52.3°F.

TABLE XXII

VARIATION IN DILUTION REQUIREMENTS.

Time	(1) Air Temp. C°	Estimated Correct-ion	Estimated Water Temp. C°	Salt Fork Dissolved O_2 Content 70% Sat. p.p.m.	(2) Estimated Sewage Rate of Flow M.G.D.	(3) % of Mean	(4) Strength Index	(5) O_2 Consumed p.p.m.
*Oct.1,1917	16.1	3.9	20.0	6.5				
Month								
Jan.	-3.8		0.0	10.2	3.9	91.	240	79
Feb.	-2.4		0.0	10.2	3.7	86	250	82
Mar.	+3.8	.9	4.7	9.0	5.1	119	200	66
Apr.	10.6	2.6	13.2	7.4	6.1	143	150	49
May	17.7	3.9	21.6	6.2	5.4	126	180	59
June	22.5	3.9	26.4	5.7	4.4	103	220	73
July	25.3	3.9	29.2	5.4	2.9	68	350	115
August	23.5	3.9	27.4	5.6	2.8	65	360	119
Sept.	19.2	3.9	23.1	6.1	3.3	77	290	96
Oct.	12.8	3.1	15.9	7.0	4.0	93	230	76
Nov.	5.4	1.3	6.7	8.6	5.3	124	180	59
Dec.	-1.2		0.0	10.2	5.5	129	170	56

* Test by State Water Survey
(1) Average of 10 years. Weather Bureau records at Urbana
(2) Estimated from records for one year.
(3) The per cent which (2) is of the mean rate of sewage flow for the year.
(4) From Plate 8 plus an addition to provide a factor of ignorance.
(5) Proportional to strength index.

TABLE XXII. Cont.

Time	(12) Required Ratio	Dilution M.G.D.	(6) Salt Fork M.G.D.	(7) Dilution Required After Sedimentation	(8) Dilution Required After Screening	(9) Ratios	(10) Ratios	(11) Ratios
Jan.	15.5	60	36	42	51	.86	.71	.60
Feb.	16.1	60	65					
Mar.	14.7	75	57	53	64		.89	.76
Apr.	13.2	81	58	57	69		.84	.72
May	19.1	103	74	72	88		.84	.72
June	25.6	113	32	79	96	.41	.33	.28
July	42.6	124	21	87	105	.24	.20	.17
Aug.	42.5	119	14	83	101	.17	.14	.12
Sept.	31.5	104	11	73	88	.15	.13	.11
Oct.	21.7	87	9	61	74	.15	.12	.10
Nov.	13.7	74	12	52	63	.23	.19	.16
Dec.	11.0	60	9	42	51	.21	.18	.15
Average						.30	.42	.35

(6) Averaged from Table 2.
(9),(10) and (11), A relative measure of the amount of treatment yet required. The smaller figures indicate the need for more complete treatment.

TABLE XXIII.

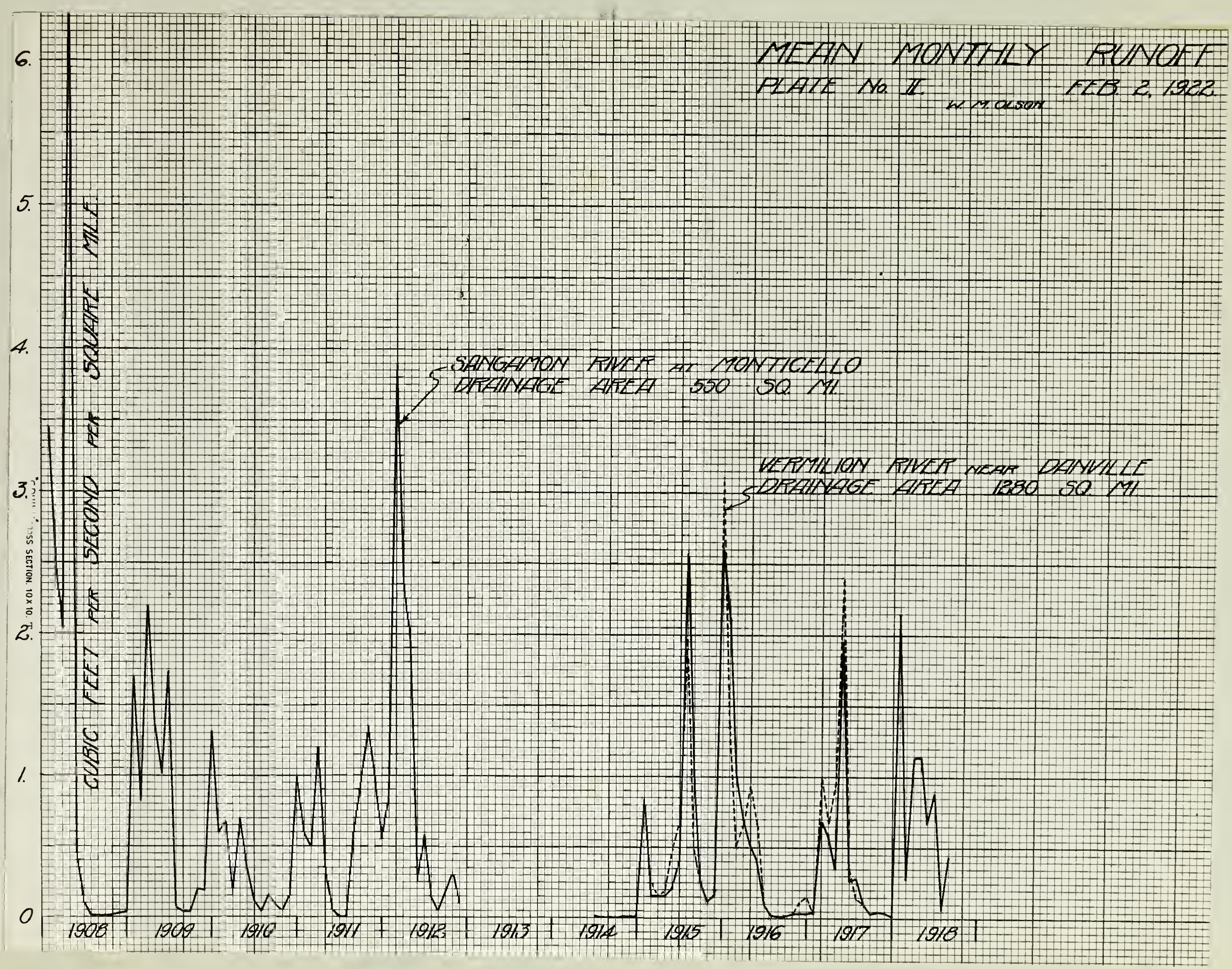
COST COMPARISON.

Process	Capacity M.G.D.*	First Cost Unit Cost per M.G.D. capacity	First Cost Total	Annual Fixed Charges at 9%	Annual Quantity M.G.	Operating Cost Unit Cost per M.G. treated	Operating Cost Annual	Annual Total	Cost Per Cap.	Total Cost per M.G. treated
Imhoff Tanks (complete)	6.1	20,700	126,300		1,475	4.00	5,900			
Sprinkling Filters	4.0	57,800	231,200		976	4.50	4,390			
Pumping Equipment	5.8	333	2,000		976	5.10	4,980			
			359,500	32,300			15,270	47,600	.79	32.30
Activated Sludge	4.0	57,100	228,400	20,500	1,475	38.90	57,300	77,800	1.28	52.70

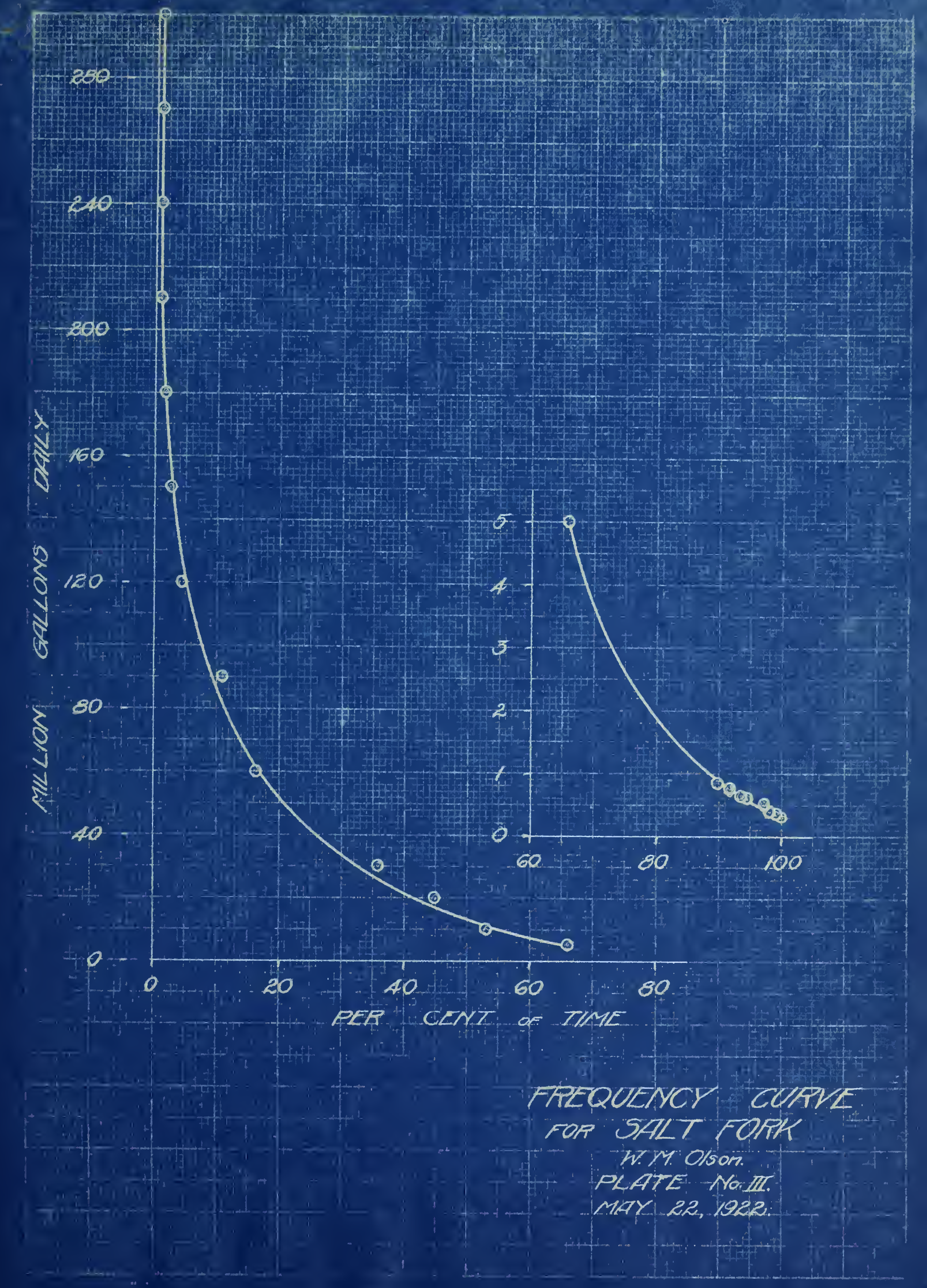
Data given by Mr.H.P.Eddy, Engineering Record, Vol.74,p.557,1916 for the 5.5 M.G.D. Plant at Fitchburg , Mass.

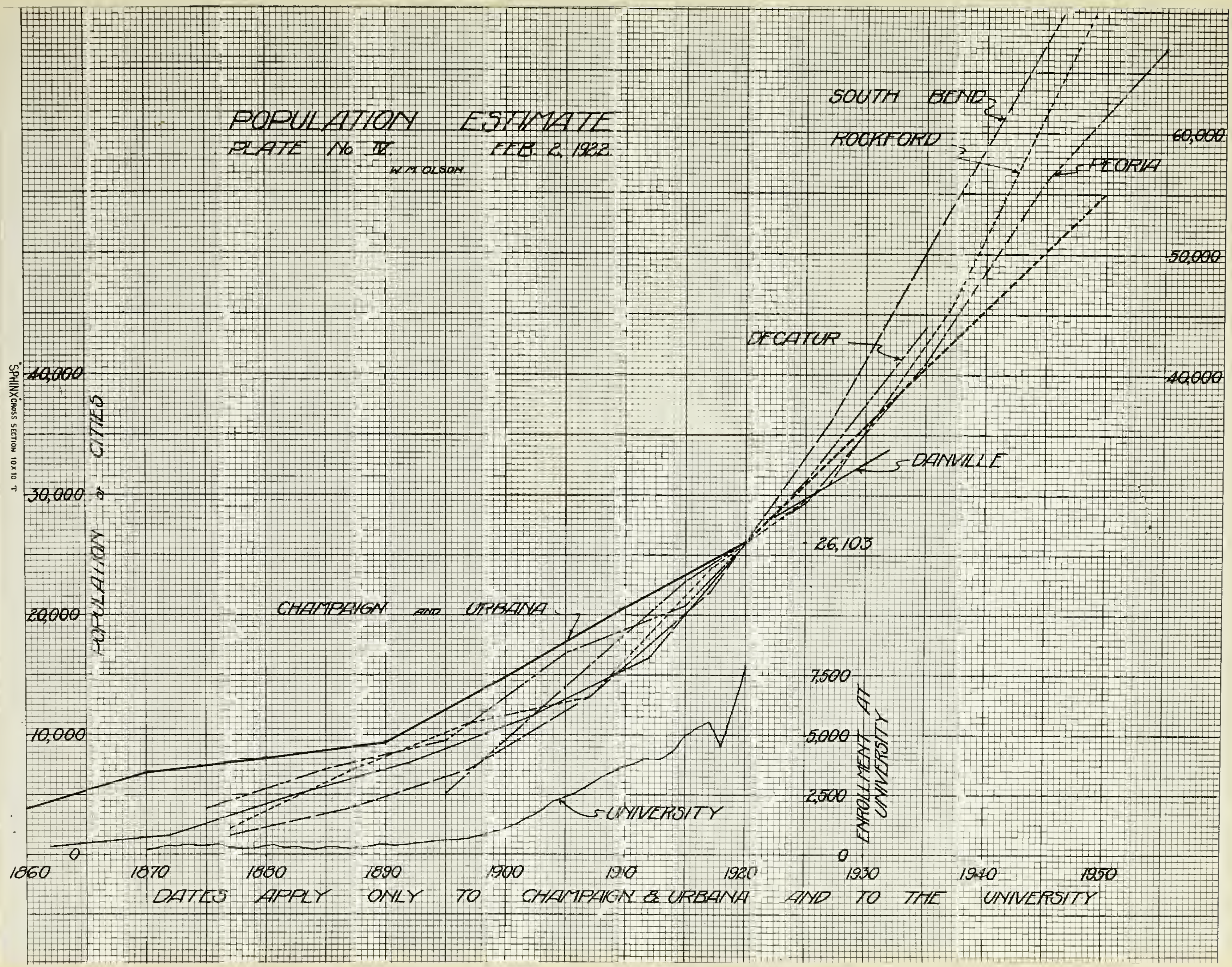
Process	Capacity M.G.D.*	First Cost Unit Cost per M.G.D. capacity	First Cost Total	Annual Fixed Charges at 9%	Annual Quantity M.G.	Operating Cost Unit Cost per M.G. treated	Operating Cost Annual	Annual Total	Cost Per Cap.	Total Cost per M.G. treated
Imhoff Tanks and Sprinkling Filters		78,500				8.50			.80	21.84
Activated Sludge		57,100				20.00			1.09	29.85

* M.G.D. = Million Gallons Daily

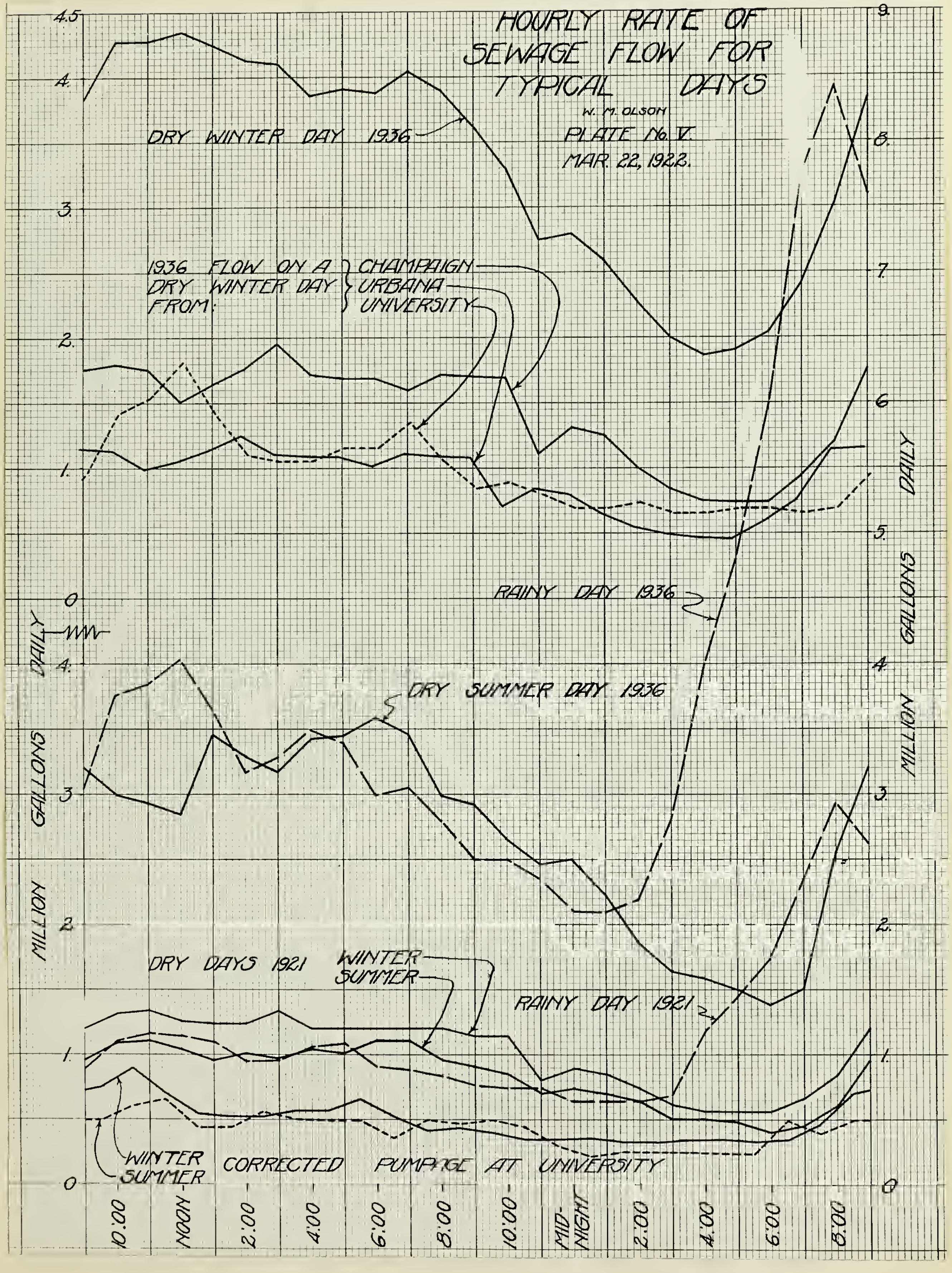


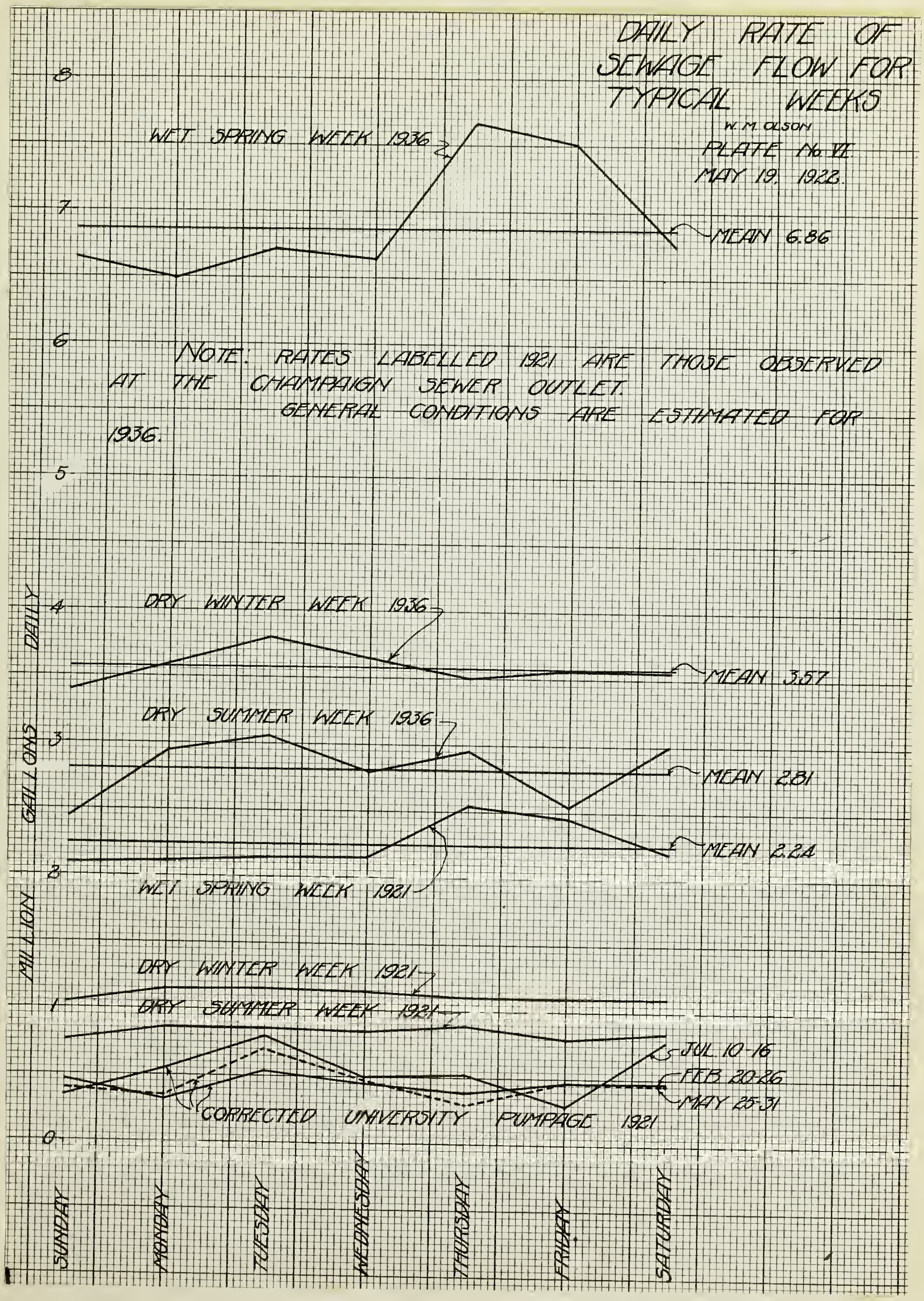
MEAN MONTHLY RUNOFF
PLATE No. II
W. M. OLSON
FEB. 2, 1922.
SANGAMON RIVER AT MONTICELLO
DRAINAGE AREA 550 SQ. MI.
VERMILION RIVER NEAR DANVILLE
DRAINAGE AREA 1280 SQ. MI.
CUBIC FEET PER SECOND PER SQUARE MILE
0
1.
2.
3.
4.
5.
6.
1908
1909
1910
1911
1912
1913
1914
1915
1916
1917
1918
CROSS SECTION. 10 X 10.

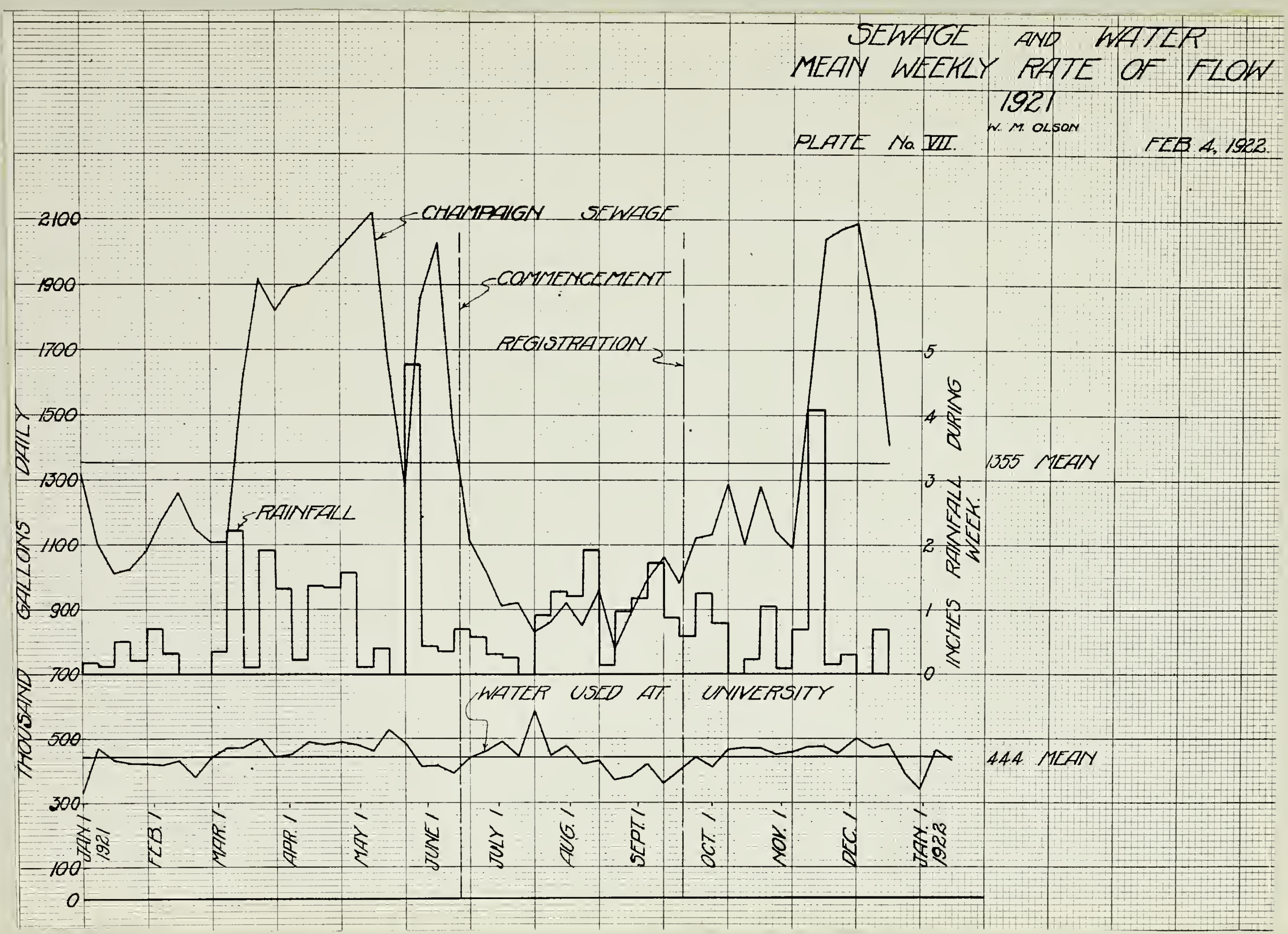

250
240
200
160
120
80
40
0
MILLION GALLONS DAILY
0
20
40
60
80
PER CENT OF TIME
5
4
3
2
1
0
60
80
100
FREQUENCY CURVE
FOR SALT FORK
W. M. Olson.
PLATE No. III.
MAY 22, 1922.

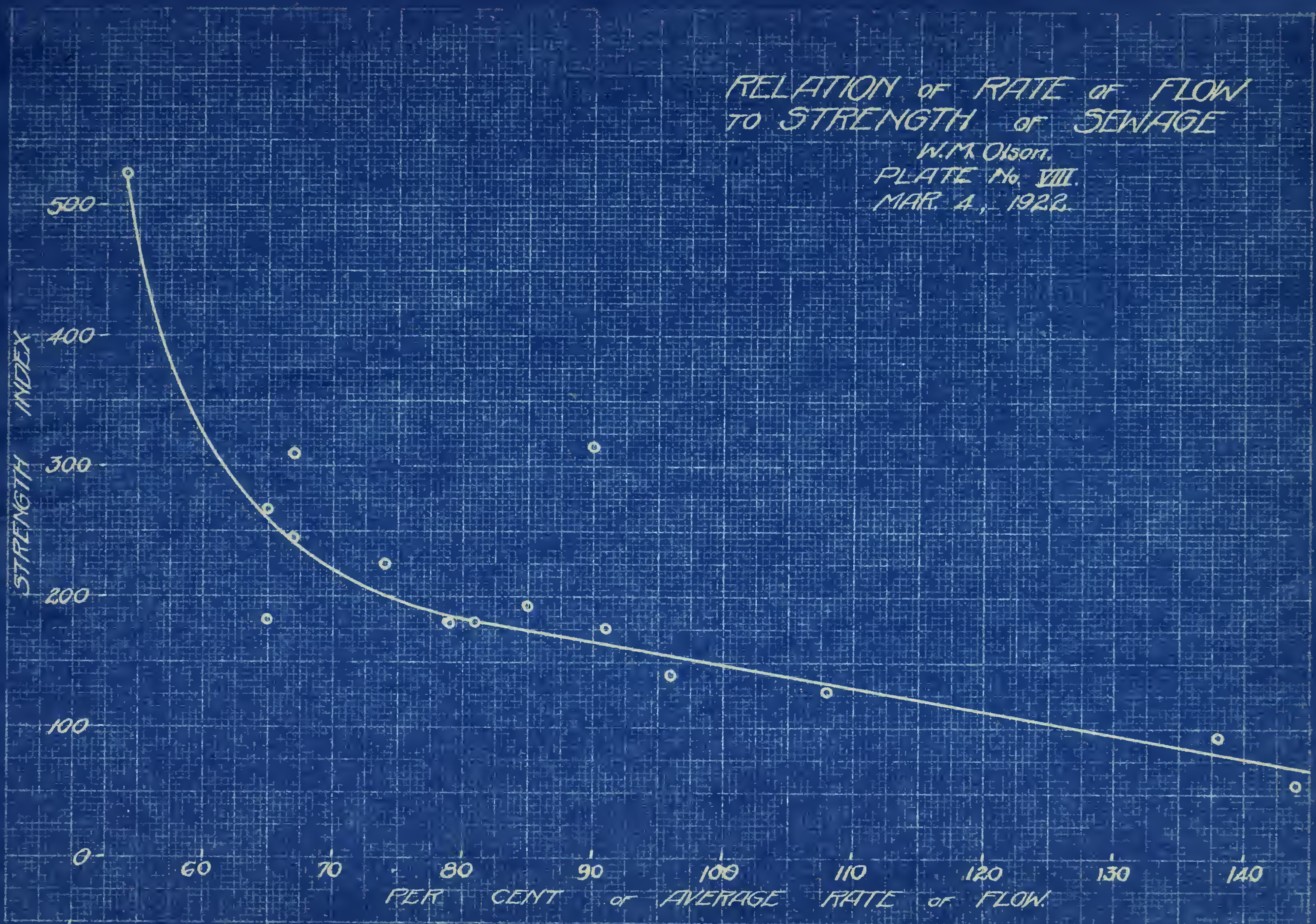


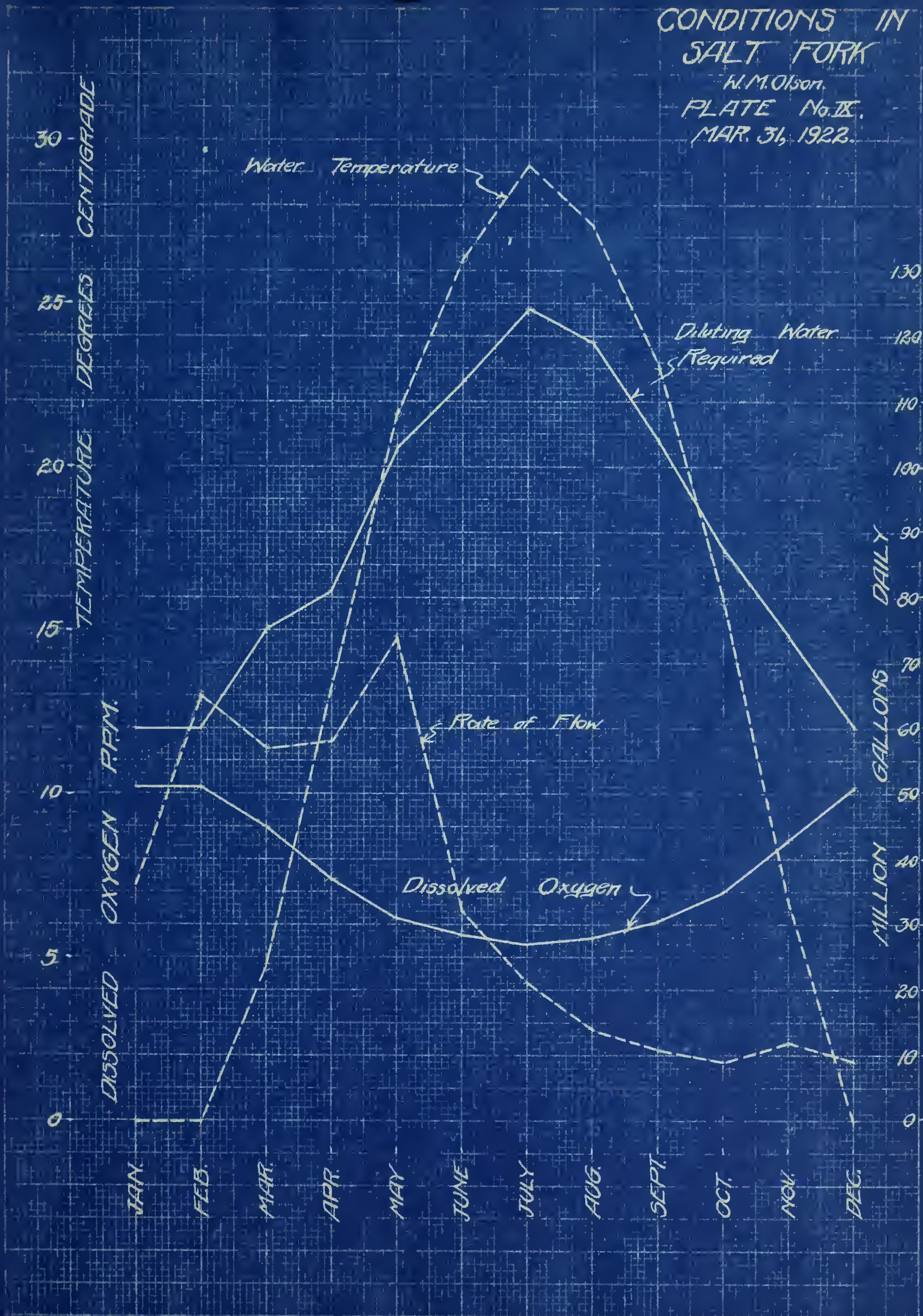
POPULATION ESTIMATE
PLATE No IV FEB. 2, 1922.
W. M. OLSON
SOUTH BEND
ROCKFORD
PEORIA
DECATUR
DANVILLE
26,103
CHAMPAIGN AND URBANA
UNIVERSITY
POPULATION OF CITIES
ENROLLMENT AT UNIVERSITY
0
2,500
5,000
7,500
10,000
20,000
30,000
40,000
50,000
60,000
1860
1870
1880
1890
1900
1910
1920
1930
1940
1950
DATES APPLY ONLY TO CHAMPAIGN & URBANA AND TO THE UNIVERSITY
SPHINX CROSS SECTION 10X10 T

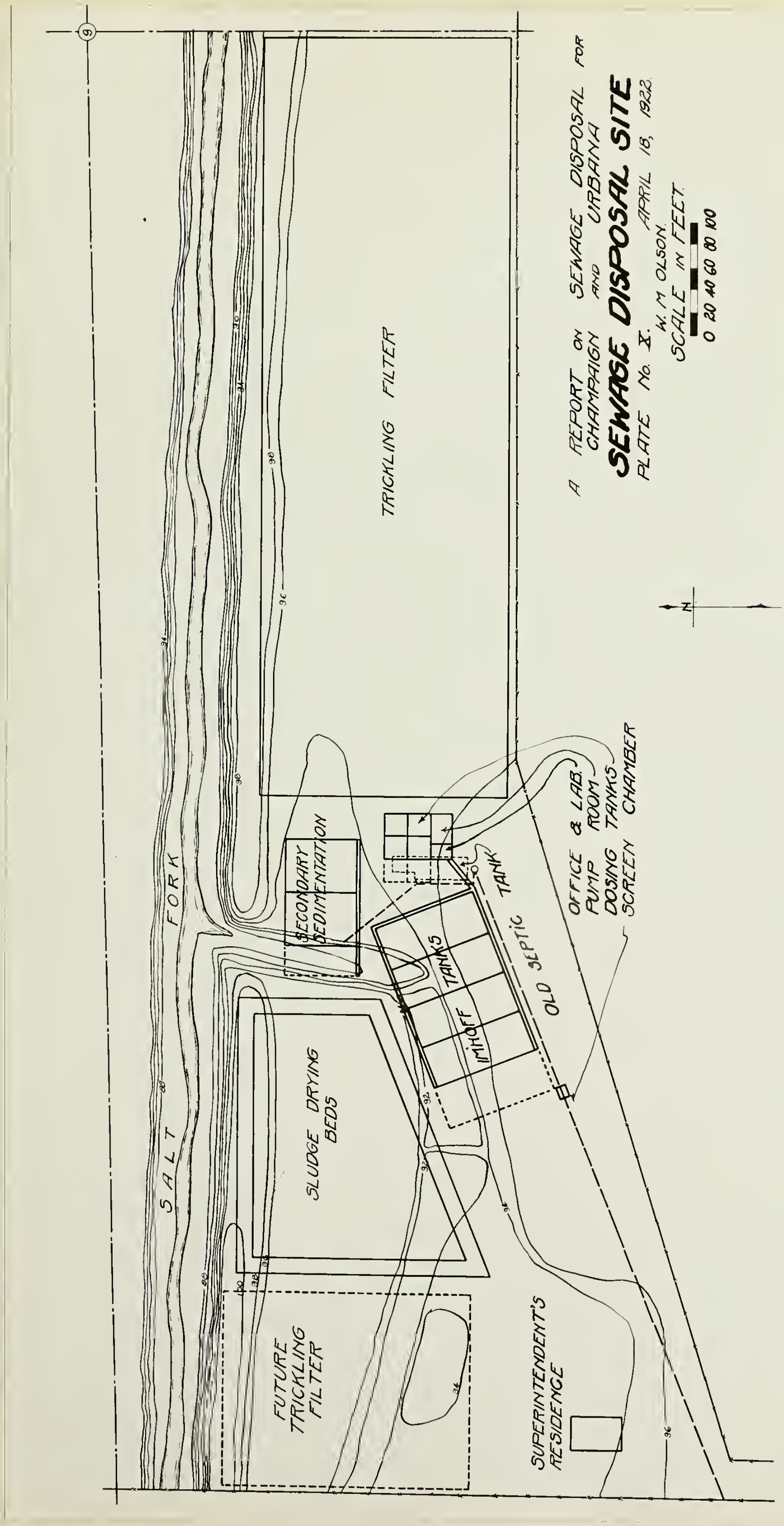

HOURLY RATE OF SEWAGE FLOW FOR TYPICAL DAYS
W. M. OLSON
PLATE No. V.
MAR. 22, 1922.
DRY WINTER DAY 1936
1936 FLOW ON A DRY WINTER DAY FROM:
CHAMPAIGN
URBANA
UNIVERSITY
RAINY DAY 1936
DRY SUMMER DAY 1936
DRY DAYS 1921
WINTER
SUMMER
RAINY DAY 1921
WINTER
SUMMER
CORRECTED PUMPAGE AT UNIVERSITY
MILLION GALLONS DAILY
4.5
4.
3.
2.
1.
0
4.
3
2
1.
0
9.
8.
7.
6
5.
4.
3.
2.
1.
0
10:00
NOON
2:00
4:00
6:00
8:00
10:00
MID-NIGHT
2:00
4:00
6:00
8:00

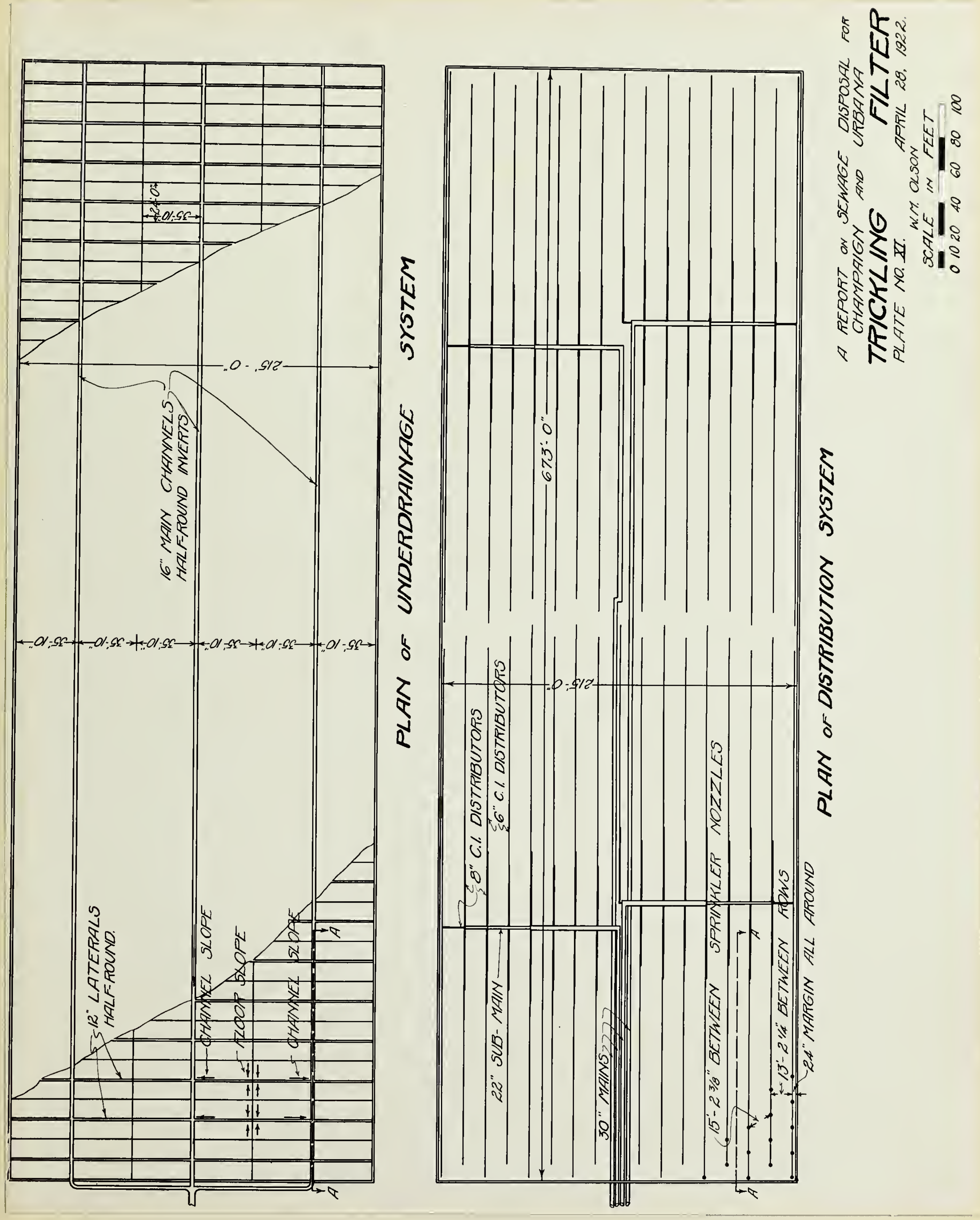

DAILY RATE OF SEWAGE FLOW FOR TYPICAL WEEKS
W. M. OLSON
PLATE No. VI
MAY 19, 1922.
WET SPRING WEEK 1936
MEAN 6.86
NOTE: RATES LABELLED 1921 ARE THOSE OBSERVED AT THE CHAMPAIGN SEWER OUTLET.
GENERAL CONDITIONS ARE ESTIMATED FOR 1936.
DRY WINTER WEEK 1936
MEAN 3.57
DRY SUMMER WEEK 1936
MEAN 2.81
MEAN 2.24
WET SPRING WEEK 1921
DRY WINTER WEEK 1921
DRY SUMMER WEEK 1921
JUL. 10-16
FEB 20-26
MAY 25-31
CORRECTED UNIVERSITY PUMPAGE 1921
MILLION GALLONS DAILY
8
7
6
5
4
3
2
1
0
SUNDAY
MONDAY
TUESDAY
WEDNESDAY
THURSDAY
FRIDAY
SATURDAY

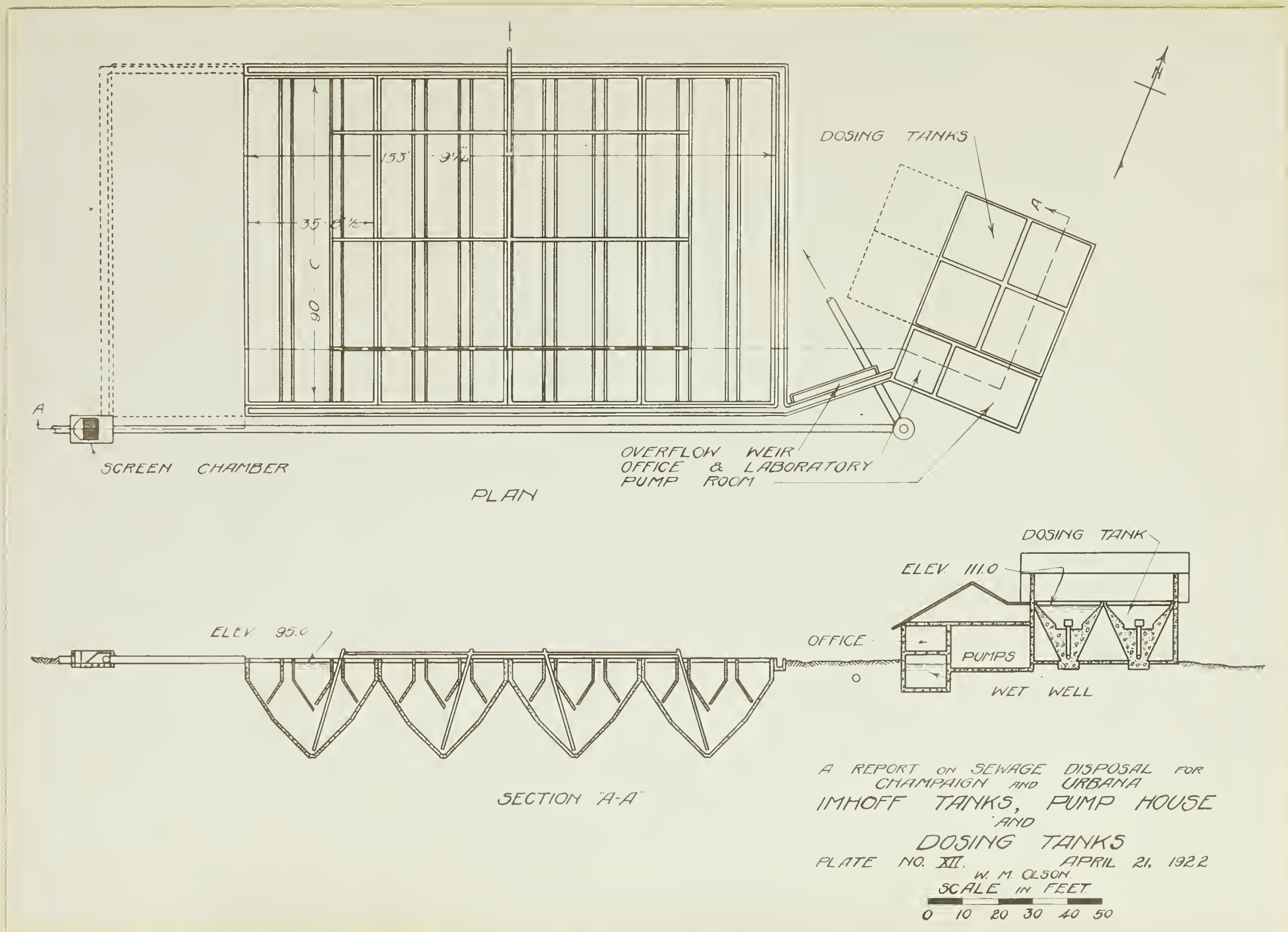

SEWAGE AND WATER
MEAN WEEKLY RATE OF FLOW
1921
W. M. OLSON
PLATE No. VII.
FEB. 4, 1922.
CHAMPAIGN SEWAGE
COMMENCEMENT
REGISTRATION
RAINFALL
WATER USED AT UNIVERSITY
1355 MEAN
444 MEAN
THOUSAND GALLONS DAILY
INCHES RAINFALL DURING WEEK.
2100
1900
1700
1500
1300
1100
900
700
500
300
100
0
5
4
3
2
1
0
JAN. 1 1921
FEB. 1
MAR. 1
APR. 1
MAY 1
JUNE 1
JULY 1
AUG. 1
SEPT. 1
OCT. 1
NOV. 1
DEC. 1
JAN. 1 1922

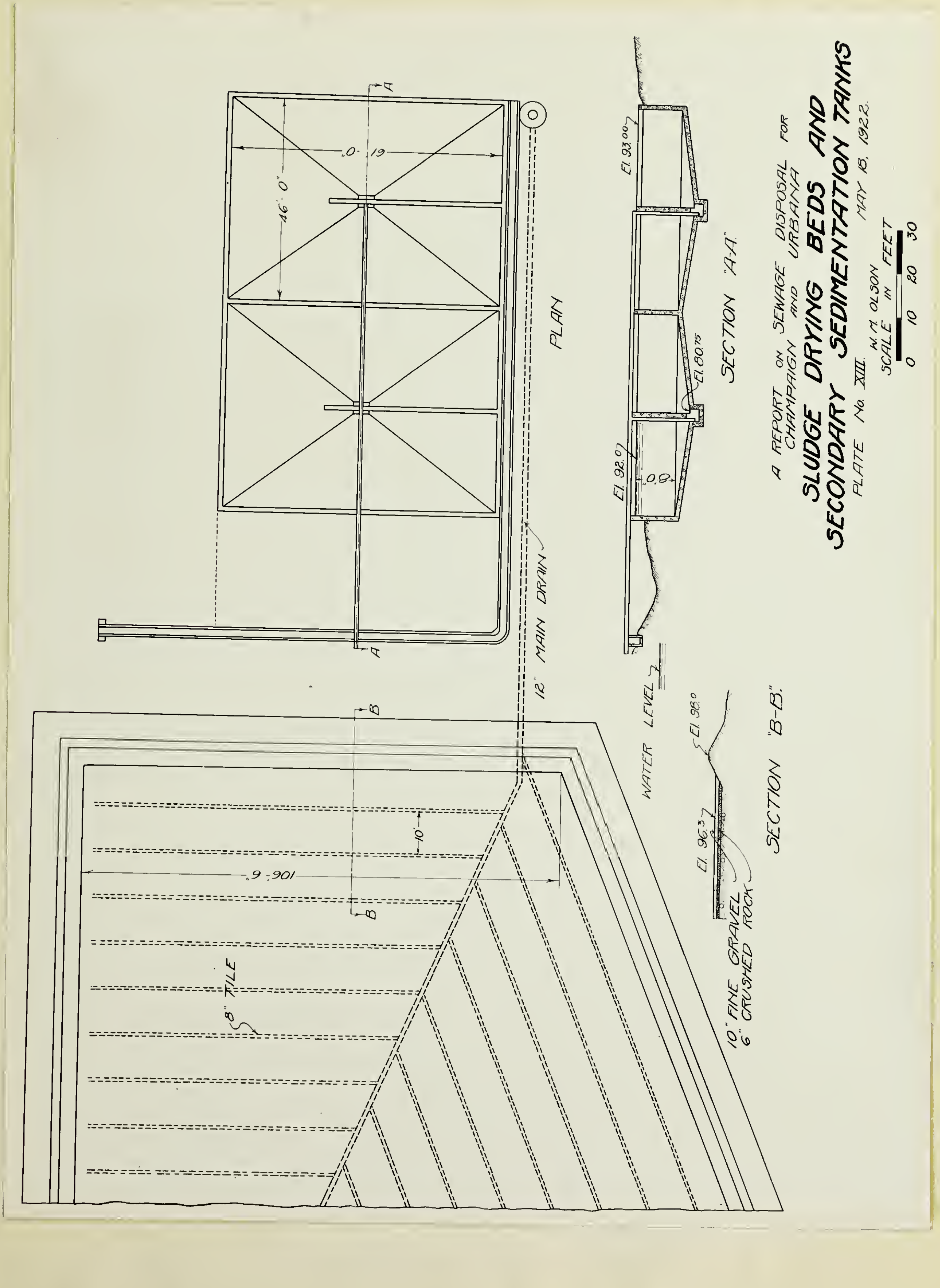

RELATION OF RATE OF FLOW
TO STRENGTH OF SEWAGE
W.M. Olson.
PLATE No. VIII.
MAR. 4, 1922.
STRENGTH INDEX
500
400
300
200
100
0
60
70
80
90
100
110
120
130
140
PER CENT OF AVERAGE RATE OF FLOW.


CONDITIONS IN SALT FORK
W. M. Olson.
PLATE No. IX.
MAR. 31, 1922.
Water Temperature
Diluting Water Required
Rate of Flow
Dissolved Oxygen
TEMPERATURE - DEGREES CENTIGRADE
DISSOLVED OXYGEN P.P.M.
MILLION GALLONS DAILY
30
25
20
15
10
5
0
130
120
110
100
90
80
70
60
50
40
30
20
10
0
JAN.
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG.
SEPT.
OCT.
NOV.
DEC.

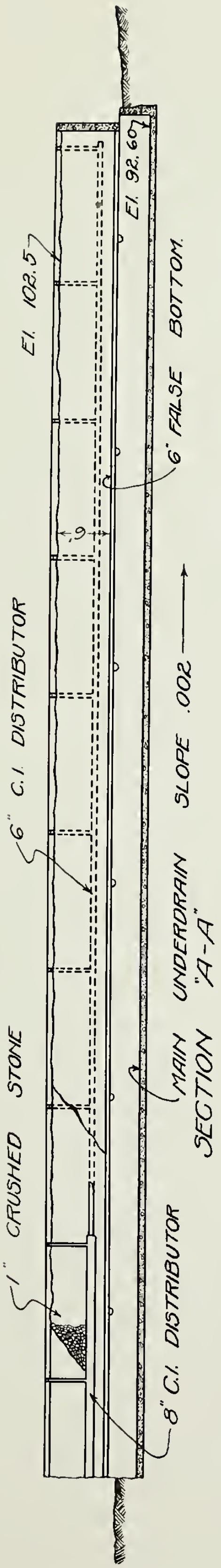

A REPORT ON SEWAGE DISPOSAL FOR CHAMPAIGN AND URBANA
SEWAGE DISPOSAL SITE
PLATE No. X. APRIL 18, 1922.
W. M. OLSON.
SCALE IN FEET
0 20 40 60 80 100
N
TRICKLING FILTER
SECONDARY SEDIMENTATION
IMHOFF TANKS
OLD SEPTIC TANK
OFFICE & LAB.
PUMP ROOM
DOSING TANKS
SCREEN CHAMBER
SLUDGE DRYING BEDS
FUTURE TRICKLING FILTER
SUPERINTENDENT'S RESIDENCE
SALT FORK


16" MAIN CHANNELS
HALF-ROUND INVERTS
215' - 0"
35'-10"
2'-0"
12" LATERALS
HALF-ROUND.
CHANNEL SLOPE
FLOOR SLOPE
CHANNEL SLOPE
A
A
PLAN OF UNDERDRAINAGE SYSTEM
673'-0"
215'-0"
8" C.I. DISTRIBUTORS
6" C.I. DISTRIBUTORS
22" SUB-MAIN
30" MAINS
15'-2 3/8" BETWEEN SPRINKLER NOZZLES
13'-2 1/4" BETWEEN ROWS
24" MARGIN ALL AROUND
A
A
PLAN OF DISTRIBUTION SYSTEM
A REPORT ON SEWAGE DISPOSAL FOR
CHAMPAIGN AND URBANA
TRICKLING FILTER
PLATE NO. XI. APRIL 28, 1922.
W.M. OLSON
SCALE IN FEET
0 10 20 40 60 80 100


DOSING TANKS
153' 9½"
35 8½
90
A
SCREEN CHAMBER
OVERFLOW WEIR
OFFICE & LABORATORY
PUMP ROOM
PLAN
DOSING TANK
ELEV. 111.0
ELEV. 95.0
OFFICE
PUMPS
WET WELL
SECTION "A-A"
A REPORT ON SEWAGE DISPOSAL FOR
CHAMPAIGN AND URBANA
IMHOFF TANKS, PUMP HOUSE
AND
DOSING TANKS
PLATE NO. XII. APRIL 21, 1922
W. M. OLSON.
SCALE IN FEET
0 10 20 30 40 50



A REPORT ON SEWAGE DISPOSAL FOR CHAMPAIGN AND URBANA
SLUDGE DRYING BEDS AND SECONDARY SEDIMENTATION TANKS
PLATE No. XIII.
MAY 18, 1922.
W. M. OLSON
SCALE IN FEET
0 10 20 30
PLAN
46'-0"
61'-0"
12" MAIN DRAIN
SECTION "A-A"
El. 93.00
El. 92.0
El. 80.75
8'-0"
WATER LEVEL
SECTION "B-B"
El. 98.0
El. 96.3
10" FINE GRAVEL
6" CRUSHED ROCK
8" TILE
10'
106'-6"



TRICKLING FILTER
PLATE No. XIV. MAY 10, 1922.
W. M. OLSON
SCALE IN FEET
0 5 10 20